Yosemite National Park

Field Monitoring Guide

Visitor Experience and Resource Protection Program

United States Department of the Interior
National Park Service
Yosemite National Park
California

2006

FIELD MONITORING GUIDE
VISITOR EXPERIENCE AND RESOURCE PROTECTION PROGRAM

UNITED STATES DEPARTMENT OF THE INTERIOR
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SECTION A:

INTRODUCTION

A.1 BACKGROUND

The National Park Service is charged to protect the quality of park resources while providing for their enjoyment by this and future generations. This is the essential mission outlined in the 1916 Organic Act (Public Law 16 U.S.C. 1) establishing the National Park Service and it suggests that a balance be maintained between resource protection and visitor use. Today, there are hundreds of National Park units accommodating millions of visitors each year. This poses increasing challenges for area managers trying to achieve this balance. Managers must increasingly rely on scientific data and up-to-date information as to the extent of visitor use and related impacts so that they may make informed decisions that ensure that the resources and visitor opportunities they are charged to protect remain in tact for future generations to enjoy.

The Visitor Experience and Resource Protection (VERP) framework was developed to address visitor use and related issues in National Park units. VERP is a visitor use planning and management process designed to: 1) plan for desired resource and experiential conditions; 2) establish a monitoring program to track the status of these desired conditions; and 3) implement management strategies to maintain desired conditions (NPS 1997, Hof et al.1997).

Overall, the VERP process helps the National Park Service to address a variety of visitor use-related issues including user capacity. The National Parks and Recreation Act of 1978 (P.L. 95-625) stipulates that National Park units "identify and implement commitments for visitor carrying capacities for all areas of the unit". Originally, the carrying capacity concept referred to the level of use by a particular species that a particular land area could effectively accommodate. As applied to visitor use in national parks and other protected areas this concept is known as "user capacity" and refers to the types and levels of visitor use that a given protected area can accommodate before the values for which the area had been established are unacceptably affected (NPS 1997; Manning 1999).

Since the early 1990s, the VERP process has been initiated and / or implemented in several national park units across the country. In Yosemite, the VERP process has been applied to develop plans for the future of Yosemite Valley and the Merced River Corridor (YOSE 2000; 2001; 2004). It represents a significant effort of the park in tackling user capacity and other visitor-related issues through a systematic and adaptive management framework (NPS 1997). Currently, the park is also applying VERP to the Tuolumne Wild and Scenic River.

The objective of the VERP monitoring program is to provide park managers with up-to-date, scientific data and information on visitor use and related impacts. The VERP monitoring program is a key component of a cyclical process of adaptive visitor use management in the park. It also provides a means to inform park partners and the public as to the current status of resource and visitor use conditions.

A.2 INDICATORS AND STANDARDS

In the VERP process *indicators* are measurable, manageable variables that reflect the condition of park resources and the quality of visitors' experiences. *Standards* reflect the desired condition of these variables (Manning 1999). The User Capacity Management Program for the Merced Wild and Scenic River defined a suite of 8 selected indicators. (YOSE 2001; YOSE 2004). These indicators were first monitored in 2004. However, after several iterative evaluations and marked improvements this original set of indicators has evolved into the current list as follows:

INDICATOR 1: Water Quality
Zones: 1D Designated Overnight, 2A Open Space, 2C Day Use, 2D Attraction, 3A Camping, 3B Visitor Base and Lodging, 3C Park Operations and Administration, but it is more practical to establish standards by segment than by zone
Standards: Anti-degradation for each segment, for fecal coliform, nutrients (total nitrogen and total phosphorus), and petroleum hydrocarbons per sampling period. Absolute minimum for all segments: State fecal coliform standard for recreational contact at all times.

INDICATOR 2: Riverbank Erosion
Zones: 2B Discovery, 2C Day Use
Standards: No net increase over baseline (from 2005 inventory) in linear extent of river bank erosion that is accelerated or caused by visitor use, and no riverbank segment RCI to exceed X.

INDICATOR 3: Wildlife Exposure to Human Food
Zones: 2C Day Use, 2D Attraction, 3A Camping, 3B Visitor Base and Lodging.
Standards: 95% or greater compliance with food storage regulations at selected campgrounds and parking areas.

INDICATOR 4: Extent and Condition of Social Trails
Zones: 2A Open Space, 2A+ Undeveloped Open Space
Standards: No net increase in density of social trails when compared with baseline. Baseline established 2004 and 2005. Baseline will be updated as restoration actions are implemented and data is recollected to reflect restoration efforts. Density of barren trails will not exceed X m/m^2 .

INDICATOR 5: Number of Encounters with Other Parties in Wilderness
Zones: 1A Untrailed, 1B Trailed Travel
Standards: Zone 1A Un-trailed—No more than one encounter with another party per four hour period, 80% of the time.

Zone 1B Trailed Travel—No more than one encounter with another party per hour, 80% of the time.

INDICATOR 6: Number of People At One Time (PAOT)
Zones: 1C Heavy Use Trail, 2A Open Space, 2A+ Undeveloped Open Space, 2B Discovery, 2C Day Use, 2D Attraction
River Standard: No net increase from 2005 baseline of number of people in River Protection Overlay at selected sites.
Trail Standard: Not more than 20 people on a 50-meter section of trail at any one time, 80% of the time.
Attraction Sites Standards: To be determined.

INDICATOR 7: Parking Availability
Zones: 2C Day Use, 3B Visitor Base and Lodging
Standard: The number of instances (time) when designated parking is full (requiring alternative parking actions) will occur on no more than X days per year (season) and X hours on average/day (for visitors, transit buses, and commercial tour buses).

INDICATOR 8: Usability of Ethno-botanical Resources
Zones 2B Discovery, 2C Day Use, 2D Attraction.
Standards: A standard for this indicator is currently under consideration.
In addition to these established indicators, work was conducted in 2006 on three pilot indicators as follows:

Pilot Indicator 1: Human Impact to Archeological Resources
This work explored the applicability of the National Park Service's Archeological Site Impact Monitoring System (ASMIS) to monitor visitor use impacts to archeological resources.

Pilot Indicator 2: Formal Trail Assessments
This work involved the testing of a protocol for assessing the condition of established formal trails.

Pilot Indicator 3: Soundscape Resources Assessments
This work included the measurement and inventory of baseline sounds and sound levels. It also included a social science research project to explore for visitor perceptions and evaluations of sounds and corresponding sound levels.

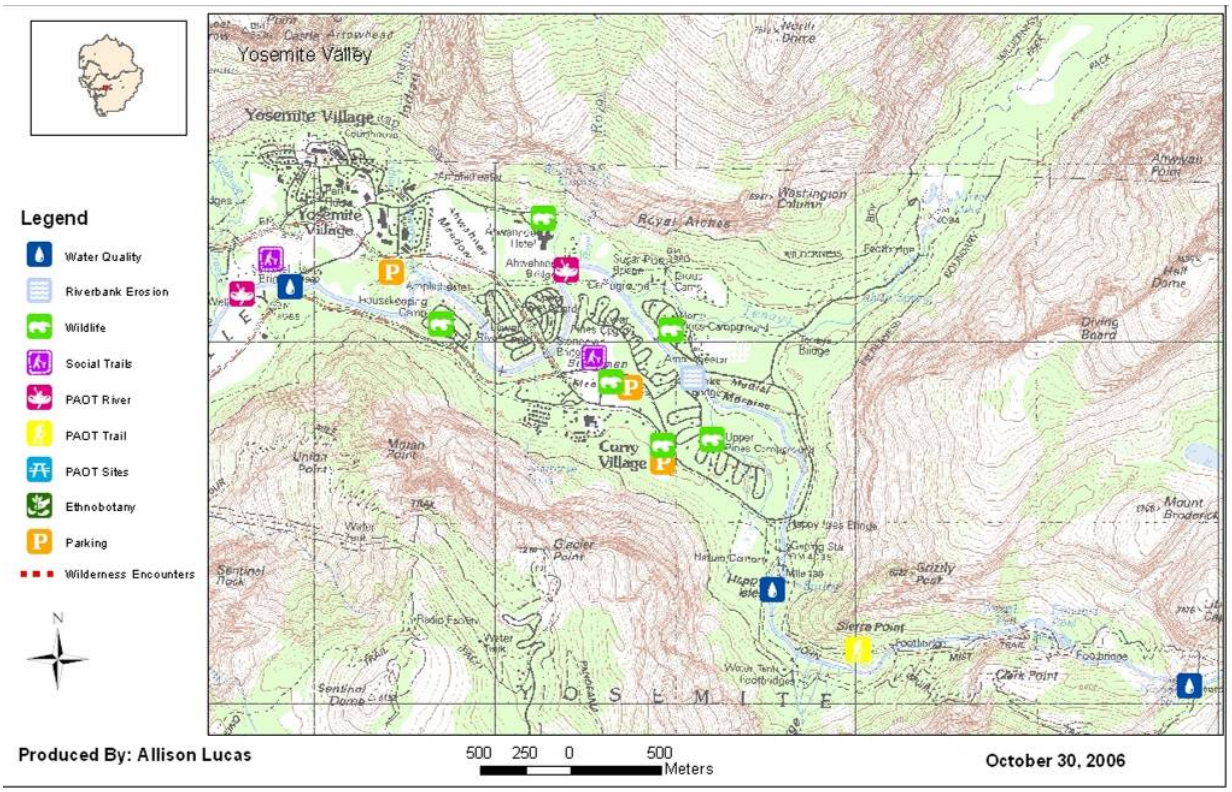
Monitoring these indicator variables requires the development of protocols that allow NPS staff to collect data in order to understand current use, impact, and trends. Creating a robust and accurate measurement strategy requires a good sampling plan. Sampling is a systematic approach to collecting data. A good sample will accurately represent estimates of population values. Watson et al (2000) outlined seven components of a good sampling strategy.

- Bias in the sampling can be eliminated by randomization.
- Probability sampling can be used to measure precision sample results.
- Patterns and landscape characteristics of wilderness use usually do not allow for census measurements in a field season.
- Good sampling strategies require fewer personnel hours.
- Well designed sampling leads to higher accuracy in the data.
- Flexibility is very important to managers who are challenged to multi-task and maximize productivity with minimal personnel resources.
- Sampling should not burden visitors.

These sampling strategy components can be generalized to all indicators measured. However, as with all monitoring programs some constraints exist including time, limited budgets, or other stochastic events such as weather, medical emergencies, and unforeseen circumstances. Therefore, NPS staff should know the standard error associated with the number of days or times that an indicator is measured. Generally, the higher the sample size, the lower the standard error. For several of the indicators, the standard error can be calculated to help NPS staff be informed about such conditions. All of these components of a good sampling strategy were incorporated into development of this field guide. Sampling strategies were developed for each
indicator that will be efficient yet provide the data required to address whether a standard has been exceeded.

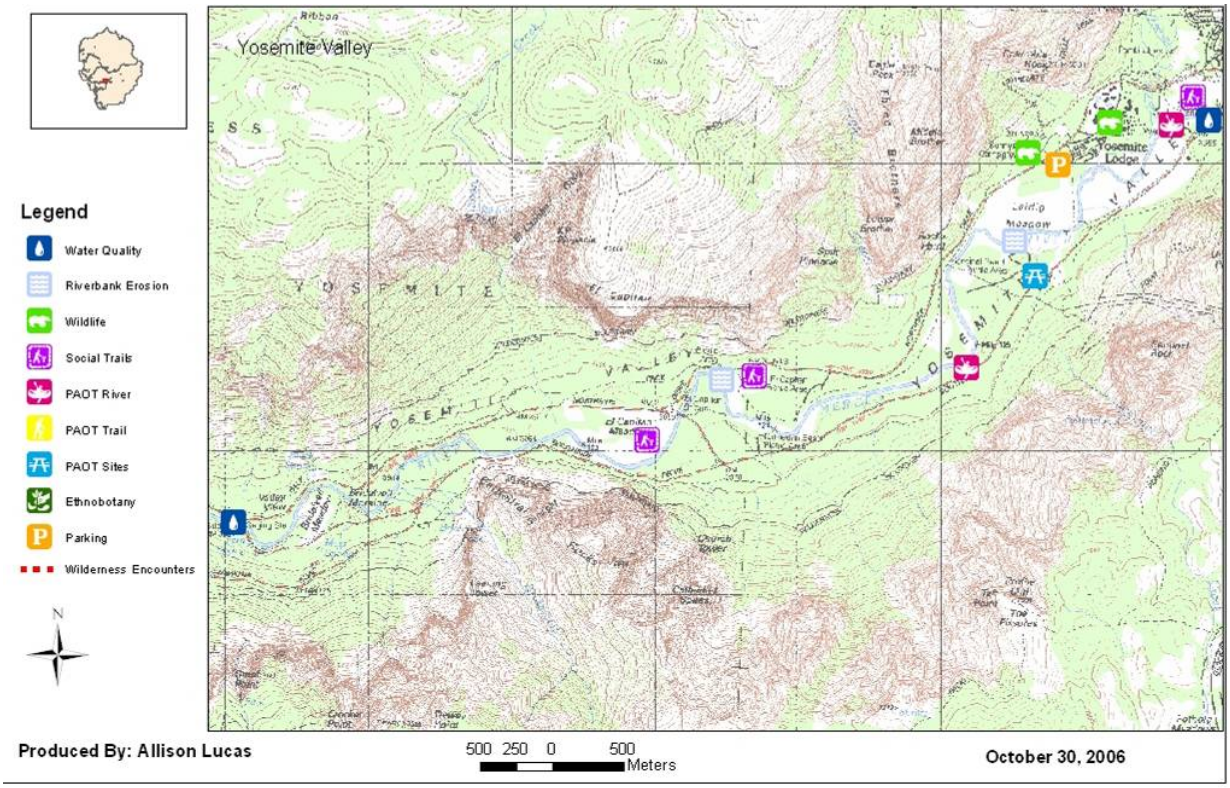
Although all of these considerations were incorporated into the development of this field guide, it is understood that it takes time to develop monitoring protocols that truly address changes in the natural or social environment. Recent research by United States Geological Survey and National Park Service staff concluded that long-term monitoring protocols take several years of field work and revisions to develop the level of confidence in the data for long-term monitoring (Oakley, et al, 2003).

The following maps present the various sampling sites for each indicator variable monitored in 2006:



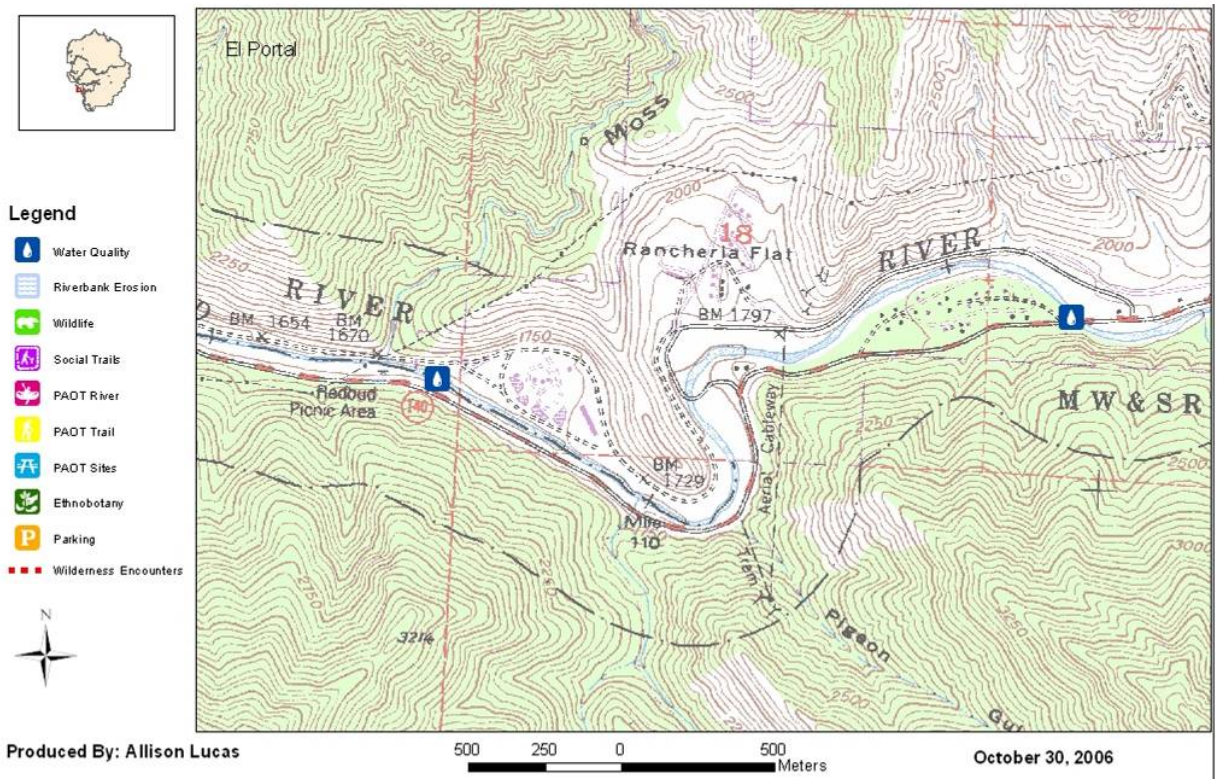
± **Note:** The specific locations of ethno-botanical resources are protected by confidentially clauses in the National Historic Preservation Act (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act.

Figure A.2.1 VERP Monitoring Sites in East Yosemite Valley



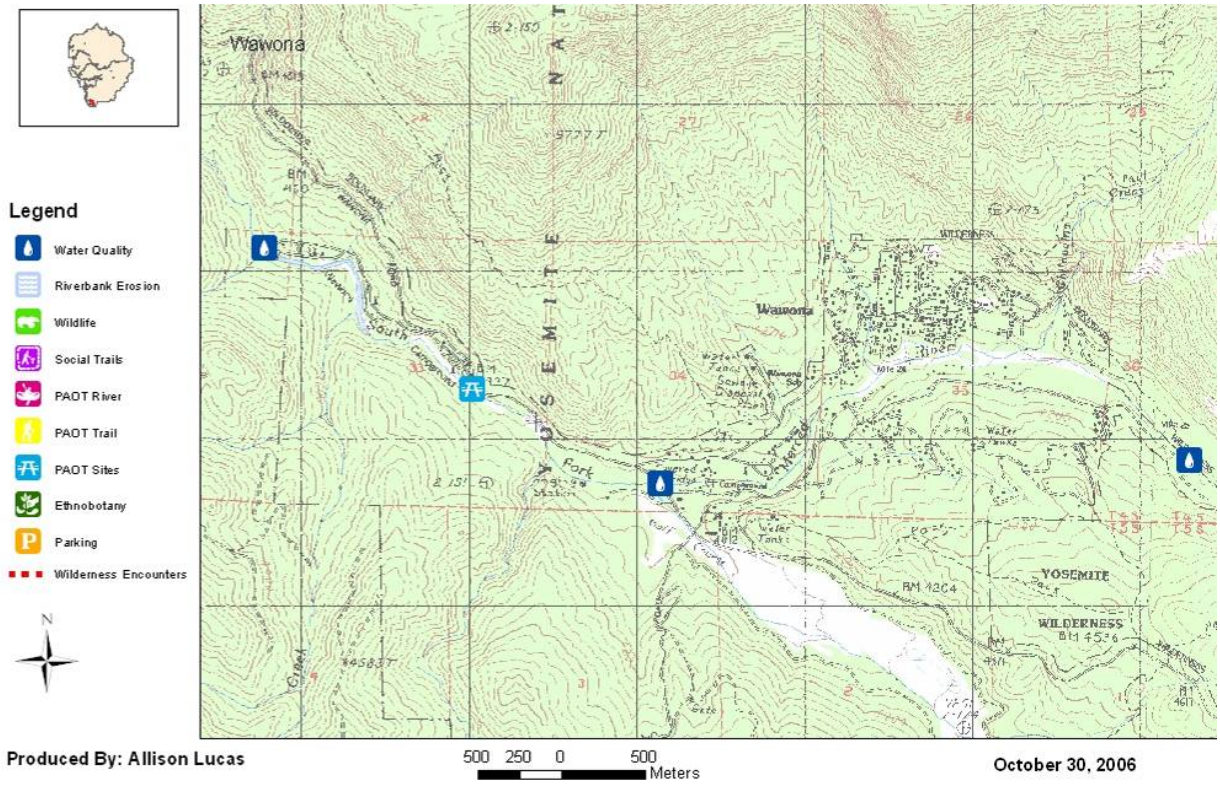
± **Note:** The specific locations of ethno-botanical resources are protected by confidentially clauses in the National Historic Preservation Act (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act.

Figure A.2.2 VERP Monitoring Sites in West Yosemite Valley



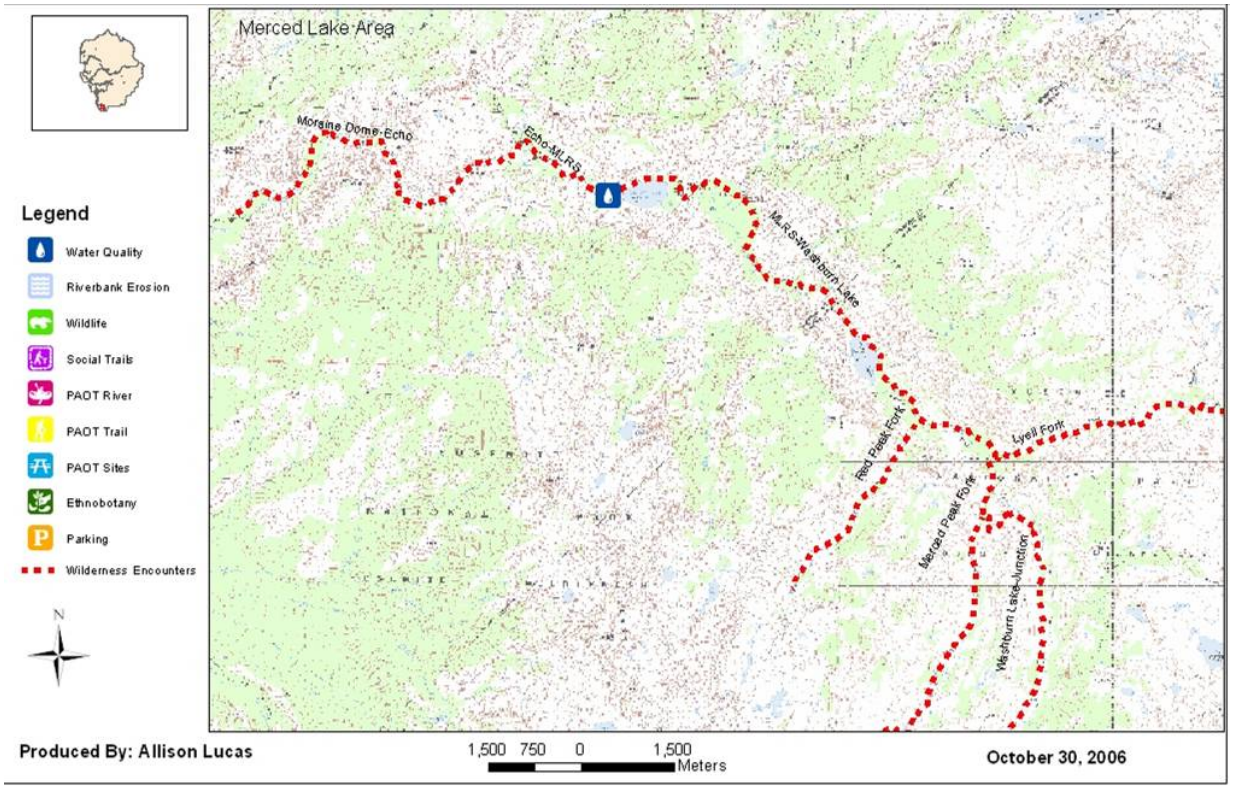
± **Note:** The specific locations of ethno-botanical resources are protected by confidentially clauses in the National Historic Preservation Act (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act.

Figure A.2.3 VERP Monitoring Sites in El Portal



± **Note:** The specific locations of ethno-botanical resources are protected by confidentially clauses in the National Historic Preservation Act (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act.

Figure A.2.4 VERP Monitoring Sites in Wawona



± **Note:** The specific locations of ethno-botanical resources are protected by confidentially clauses in the National Historic Preservation Act (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act.

Figure A.2.5 VERP Monitoring Sites in the Merced Lake Area

A.3 THE 2006 FIELD SEASON

Summary: This version of the field guide was prepared for use during the 2006 season. Readers will note that significant improvements have been made in the protocols from the 2005 season. In some cases we have moved from inventorying of baseline conditions to sampling-based strategies. Still in other cases we have refined measurement techniques. The use of pocket computers (PDA) helped to streamline data collection efforts, while database developments improved and expedited data entry and analysis. This process of improvement and refinement is essential to an on-going monitoring program and will continue in subsequent years.

This field guide is organized into the following sections:

> **Section A — Introduction**. Provides background on the VERP monitoring program and introduces the indicators monitored in 2006.
>
> **Section B — Monitoring Protocols**. Describes the field monitoring protocols employed for each indicator for the 2006 season.
>
> **Appendices** — The appendices section includes a glossary and a list of acronyms are also located in the appendices.

Compliance Statement: Compliance with institutional requirements and regulatory processes was completed for the 2006 VERP field monitoring effort. National Park Service research permits were obtained to comply with institutional requirements for conducting field research and monitoring activities in a National Park unit. Two permits were obtained as follows: 1) General monitoring activities permit # YOSE-2006-SCI-0078); and 2) Water quality sampling (permit #YOSE-2006-SCI-0094).

Additionally, the 2006 field monitoring season also included a number of activities that required the National Park Service to demonstrate compliance with the National Environmental Protection Act (NEPA). The specific types of data collected for the Tuolumne Wild and Scenic River Comprehensive Management Plan, as part of the VERP monitoring program, included water quality sampling of the Tuolumne Wild and Scenic River and documentation of social trails in the Tuolumne Meadows area.

For example, collection of water samples from the Dana Fork of the Tuolumne Wild and Scenic River requires an identification of where those sampling locations will be, and the amount of water expected to be removed from the river for each sample. The use of Geographic Information Systems (GIS) equipment to document the location of social trails required staff traversing through sensitive habitats (i.e., places the NPS would like to see people avoid). Because of the scale and duration of these types of monitoring activities were considered to be at a negligible (i.e., non detectable) level of intrusion into the "human environment," a Categorical Exclusion (CE) was the appropriate level of NEPA compliance.

The types of activities covered under the CE received for VERP data collection included: (1) Non-destructive data collection by fewer than 5 people together at one time in one area; and (2) The temporary installation of small, unobtrusive data collection devises in and adjacent to the Tuolumne River and its tributaries.

Work Plan: The following work plan (Figure A.3.6) provides an overview of the activities associated with carrying out the monitoring of VERP indicators during the 2006 field season.

ID	Task	Deliverable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.0	**Planning and Development Phase**	**Field Monitoring Guide**												
1.1	Monitoring protocol development													
1.2	Conduct development workshop													
1.3	Obtain data collection permits and conduct appropriate compliance													
1.4	Acquire data collection instruments													
1.5	Select and prepare sampling locations													
1.6	Field test data collection methods and instruments													
1.7	Conduct public meeting on indicator planning and development													
2.0	**Implementation Phase**	**Data and Information**												
2.1	Conduct field data collection													
2.2	Conduct quality control checks of data collection													
2.3	Enter data including quality control check													
2.4	Conduct public meeting on data collection efforts													
3.0	**Reporting Phase**	**Annual Report**												
3.1	Data analysis													
3.2	Prepare annual report													
3.3	Conduct evaluation workshop													
3.4	Conduct public meeting on monitoring results													

Figure A.3.1. VERP Field Monitoring Work Plan 2006

A.4 REFERENCES

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SECTION B:
MONITORING PROTOCOLS

B 1. Water Quality

B. 1.1 Background

Purpose of the Merced River Water Quality Monitoring Protocol: Human use has the potential to affect water quality. Horse manure (at stables or on trails) or people swimming in the river can increase fecal coliform (i.e. bacteriological) levels; people bathing in the river with soap can increase phosphorus/phosphate (i.e. nutrients) levels; and surface water runoff from campgrounds and stables can affect both fecal coliform and nutrient levels. These activities, as well as hydrocarbon pollution associated with roads and other development, all may occur in Yosemite Valley.

The goal of this plan is to collect baseline water quality data along the Merced River corridor. Specific objectives are to sample backcountry sections of river downstream of heavy use areas and above and below heavy use areas in Yosemite Valley, El Portal, and Wawona. A final objective is to collect high quality data that is comparable to data collected in other parks and in the Sierra Region as a means to protect water resources from human-use impacts.

Water quality standards have been established by the State of California, in accordance with the Clean Water Act, for surface waters in the San Joaquin River Basin, which includes the Merced River. Similar standards that are much more restrictive for certain indicators such as fecal coliforms have been established for Lake Tahoe under the Clean Water Act's anti-degradation policy that mandates protection of waters with existing high quality (see Lahontan Region Basin Plan). The NPS currently monitors water quality above and below the treated water discharge points for the wastewater treatment plants in El Portal (monthly) and Wawona (weekly), to assure attainment with state standards and to carry out the requirements of the operating permits. In the event of a sewage spill or direct discharge of treated water to the river, the monitoring is more frequent (potentially daily).

Description of indicator and standard
Indicator: Water quality as measured by the following constituents: *E. coli,* nutrients (total dissolved nitrogen, nitrate and nitrite, total dissolved phosphorous, and total phosphorus), and total petroleum hydrocarbons.
Standard: Anti-degradation for each segment, for *E. coli,* nutrients (total dissolved nitrogen, nitrate and nitrite, total dissolved phosphorous, and total phosphorus), and total petroleum hydrocarbons. Absolute minimum for all segments: State *E. coli* standard for recreational contact. Yosemite-specific standards, which will be much more protective than available state and federal standards, will be established once sufficient data has been obtained through this sampling protocol.

Zone(s): 1D Designated Overnight, 2A Open Space, 2C Day Use, 2D Attraction, 3A Camping, 3B Visitor Base and Lodging, 3C Park Operations and Administration

B. 1.2 Sampling Design

Rationale for sampling design: The initial sampling regime has been designed to inventory spatial and temporal water quality conditions on the Merced River with an emphasis on areas of the river adjacent to the heaviest development. Intensive sampling will take place for at least three years before standards of quality will be established. Until such time, applicable state and federal water quality standards will apply as minimum acceptable water quality standards.

Site selection (selection criteria and procedures): Sample locations are depicted in Figure () and listed in Table 3. Sites were selected based on location, co-location with other sampling efforts, and existing water quality data. In general, locations were selected to be upstream and downstream of developed areas, in order to better isolate impacts. Ongoing water quality sampling by the U.S. Geological Survey at Happy Isles Bridge, top of Nevada Falls, and below Merced Lake make these good sites for collocation of sampling. Similarly, the waste water treatment plants in El Portal and Wawona sample regularly at the Highway 41 South Fork Bridge, the Highway 140 Bridge, and the Foresta Bridge. Finally, sample sites where sampling could take place in the middle of the channel even at high flow were more desirable for accurate sampling.

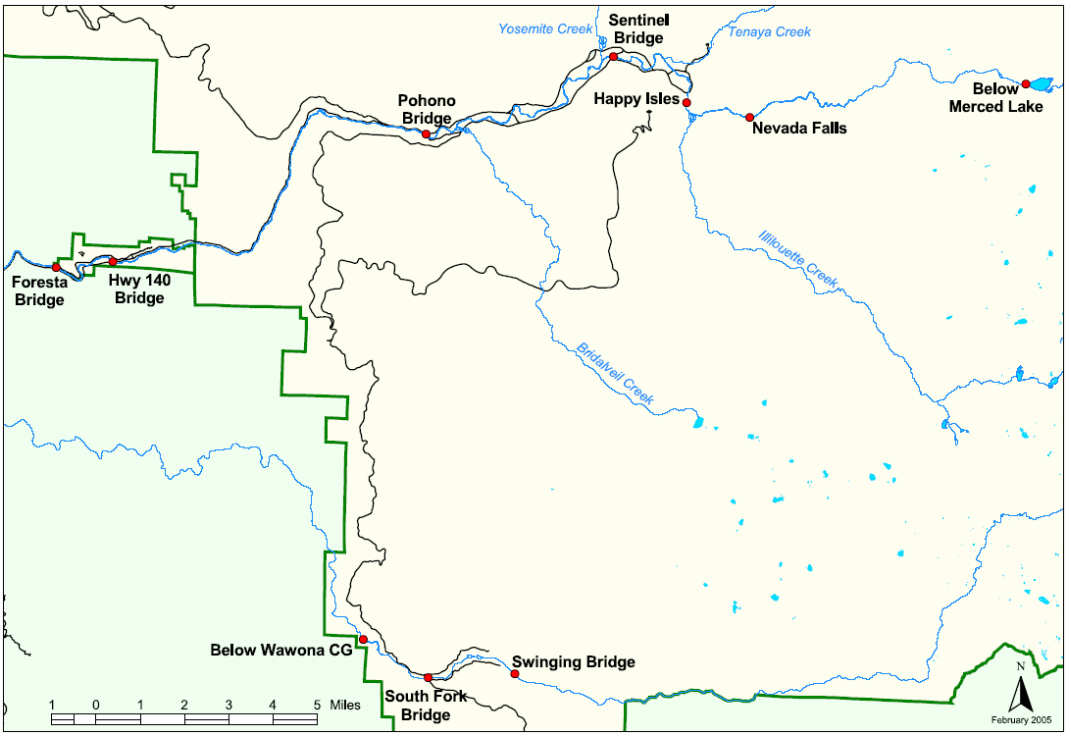


Figure B.1.1 Water Quality Sampling Locations for the Merced River

Sampling schedule: In order to understand seasonal variations in water quality, monthly sampling is conducted at all sites accept the two wilderness sites (Below Merced Lake and Above Nevada Falls). The latter are sampled monthly during the summer and fall months. In addition, intense weekly sampling is conducted at five sites (Happy Isles, Pohono Bridge, Foresta Bridge, Swinging Bridge, and below Wawona Campground) during spring runoff. Finally, sampling is conducted during or following a storm event that causes a major change in flow conditions on the river. A sampling schedule and available personnel is scheduled well in advance each spring runoff season. Fixed interval sampling generally takes place on the same days each week or month, but these times can be adjusted to accommodate schedule conflicts or personnel availability. An attempt is made to sample storms during the rising limb of the hydrograph.

B.1.3 Field Methods

The field methods described in the following section assures the collection of quality data that meets the purpose of monitoring described in the previous section. The components include data quality objectives,

instrument calibration procedures, sampling procedures, and quality control procedures. Special "Quick Guides" that encapsulate specific operational instructions are included in this section.

Data Quality Objectives: High data quality will be achieved through proper training of field technicians and adherence to the foregoing discussion of accuracy, precision, representativeness, and completeness. Chemical and Physical Parameters: Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration compared with a measured value. The accuracy of field measurements will be checked by performing tests on standard check solutions as a part of calibration procedures. Standard calibration and check solutions will be purchased from commercial labs. In addition, the accuracy of chemical measurements should be verified through use of blind audit samples. Check standards and audit samples should be in the mid-range of typical values for the Merced River.

Biological Parameters: Accuracy for bacteria will be determined by analyzing a positive control sample twice annually. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample. In general, these checks are performed as a part of a certified laboratory routine quality control.

Chemical and Physical Parameters: The precision objectives apply to duplicate and split samples taken as part of normal sampling and repeated field parameter measurements on the same sample. Precision describes how well repeated measurements agree. Duplicate or split samples prepared in the lab or field will comprise at least 5% of the samples or one set per sampling day (about 10%). Repeated field measurements on a single sample will be conducted once per sampling day.

Biological Parameters: Precision for bacterial parameters will be determined by having the same analyst complete the procedure for laboratory duplicates of the same sample. At a minimum this should be done once per day, or run duplicates on a minimum of 5% of the samples if there are over 20 samples run per day. The results of the duplicates should be within the confidence limits supplied by the manufacturer.

Comparability: Comparability is the degree to which data can be compared directly to similar studies. Sample collection methods and field parameter measurements outlined in this protocol are derived from the USGS National Field Manual and the Surface Water Ambient Monitoring Program of the California State Water Resources Control Board. Laboratory analyses will be conducted by the USGS National Water Quality Laboratory or similar USGS approved contact laboratory or, at minimum, a National Environmental Laboratory Accreditation Program (NELAP) approved laboratory. These measures should ensure broad data comparability, particularly with the National Park Service Inventory and Monitoring and Vital Signs Programs (National Park Service- Freshwater Workgroup Subcommittee 2002).

Method Detection Limit and Sensitivity: The Method Detection Limit (MDL) is the lowest possible concentration the instrument or equipment can detect. This is important to record because we can never determine that a pollutant was not present, only that we could not detect it. Sensitivity is the ability of the instrument to detect one concentration from the next. Detection Limits and Sensitivities are noted in Tables B.1.1 and B.1.2. Some labs use reporting limits in addition to the method detection limits. A reporting limit is typically 2-5 times the MDL.

Table B.1.1 Water Quality Parameter Measurement

Parameter	Method/ Range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Complete-ness
Temp.	Electronic thermometer (-5 to 50)	°C	-5	0.01 °C	± 0.01 °C	± 0.15 °C	80%
Dissolved Oxygen	Electronic meter/probe	mg/l	0.1	0.01 mg/l	± 0.01 mg/l	± 0.2 mg/l	80%
pH	pH meter	pH units	0	0.01 unit	+ 0.01 units	+ 0.2 units	80%
Conductivity	Conductivity meter	µS/cm	1	1 µS/cm	± 0.5%	± 5%	80%

Table B.1.2 Water Quality Laboratory Parameters

Parameter	Method	Units	Detection Limit	Reporting Limit	Completeness
Total Dissolved Nitrogen	USGS/NWQL 2754	mg/l	0.015	0.03	80%
Nitrate and Nitrite	USGS/NWQL 1979	mg/l	0.008	0.016	80%
Total Phosphorous	USGS/NWQL 2333	mg/l	0.002	0.004	80%
Total Dissolved Phosphorous	USGS/NWQL 2331	mg/l	0.002	0.004	80%
E. coli	SM9221F	MPN/100 ml	2	2	80%
Total Petroleum Hydrocarbons	306 MEPA SW 846	µg/l	13.0		80%

Representativeness: Representativeness describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a non-standard collection area such as downstream of a bridge
- Samples are not representative of the entire flow due to sampling in a backwater area, or not properly assuring an integrated sample
- Samples are not analyzed or processed appropriately; causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Sampling locations have been selected to minimize local impacts due to a bridge or other adjacent structure. Foresta Bridge is the only location where samples are collected downstream of the bridge both for safety reasons and to sample at the same location as El Portal Waste Water treatment plant personnel. Integrated sampling has been done when possible from bridges or by wading using a centroid sample. Otherwise, grab samples are collected as close to the main flow as possible to minimized backwater effects. Side-by-side comparison of grab sampling and centroid sampling or equal-width interval sampling has been and continues to be conducted to characterize the variability associated with grab sampling alone. All field parameter measurements are conducted at the sampling sites. All samples are to be held at 4°C and analyzed within the specified hold times.

Completeness: Completeness reflects the ratio of valid laboratory results to number of samples actually sampled. The goal is 80% sample validity. This ratio may be increased as this program matures.

Before modifying these methods, or developing alternative or additional methods, technical advisors will evaluate and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

Instrument Calibration Procedures: Instrument calibration and checks should be conducted at least twice per day, including a check of the calibration following collection of the last sample. Calibration checks are intended to verify the calibration of the instrument. The following table specifies post calibration check error limits. If the instrument does not read within these limits, perform the calibration sequence again.

Post Calibration Check Error Limits:

Parameter	Value
Dissolved oxygen	± 0.5 mg/L, ± 6% saturation
pH	± 0.2 standard units
Specific conductance	± 5%
Temperature	± 0.2 °C, annual calibration check

Instruments to calibrate will be the multi-parameter probe for measuring temperature, pH, specific conductivity, and dissolved oxygen and the smaller packable unit for temperature and conductivity. Calibration procedures will vary by instrument but the following provides a general outline of the procedure and a form to record calibration results.

Temperature: Conductivity, pH, and dissolved oxygen are all temperature compensated qualities and therefore it is critical that temperature be measured accurately. Temperature accuracy should be verified periodically via a side-by-side comparison with a NIST-traceable thermometer every three months during regular field measurements and then document in the notes section on the calibration form.

Both the multi-parameter probe and the NIST-traceable thermometer should be sent to the manufacturer once per year to verify or adjust calibration. All calibration certificates should be filed with field data for the period that the calibration was valid.

Specific Conductivity: Calibration should be performed once per sampling day. The calibration should be checked after the last sample has been collected to ensure the instrument has maintained its calibration.

- If the probe has been in storage, soaking in deionized (DI) water may be necessary to ensure the probe is thoroughly wetted prior to use. Equilibrating the probe in DI water for 10 minutes is recommended. Consider immersing the probe in DI water in a clean durable container before heading to the field.
- To calibrate the meter for specific conductivity, use a conductivity standard solution of around 1000 µS/cm. A single point calibration will be adequate.
- Immerse the probe into the standard and agitate vertically to ensure there are no air bubbles trapped. Allow time for the reading to stabilize.
- Record the value of the calibration standard, the manufacturer and lot number, and the expiration date.

- Triple rinse the probe with DI water and then with the check solution This solution should be another conductivity standard around 750 µS/cm.
- Record the manufacturer's value for the check solution, the solution temperature, the manufacturer and lot number, and the expiration date.
- Immerse the probe in the check solution and record the measured value. This is the Initial Calibration Check (ICC).
- Record Continuing Calibration Checks (CCC) at the end of the day and record this value and the time. The difference should be less than 5%.

pH: Calibrate the pH meter before the start of sampling. In addition, the meter accuracy should be verified using a check standard close in value to the river water. A final check of the instrument should be done after the last sample is taken.

- Triple rinse electrode with DI water.
- Calibrate and operate in temperature-compensation mode using pH = 4.00 and 7.00 buffer solutions. Record the value of each buffer standard, the manufacturer and lot number, and the expiration date.
- Rinse the probe with DI water and blot the excess.
- Check using a buffered check solution of pH 5-6. Immerse the electrode into the solution and stir briefly.
- Record the manufacturer's value, the measured value (ICC or CCC), temperature, the manufacturer and lot number, and expiration date.
- Rinse the probe with DI water, blot dry, and make field measurement.

Dissolved Oxygen: Clean the sonde and stirrer under running tap water to remove debris. Swab the DO membrane and pH probe with a cotton ball soaked in Alconox or methanol. This removes surface films that may cause the calibration to drift. Check the condition of the membrane. Ensure the membrane is intact; free of wrinkles, bubbles, and surface films; and not discolored below the membrane.

- Fill the calibration cup with water to just below the O-ring, securing the DO membrane.
- Carefully remove any water droplets from the membrane with a Kimwipe or soft towel.
- Cap the calibration cup and allow it to stabilize for about five minutes.
- Select Calibrate, (%) Saturation, and then enter the correct barometric pressure (mm-Hg) and hit Enter.

Data Collection, Measurement, and Post-collection Processing:

Table 3 lists sampling locations and analytes to be sampled. Eight front-country (accessible by vehicle) sites will be sampled monthly. Five of these eight sites will be sampled following major storm events and weekly during the peak spring runoff period. An additional two backcountry sites will be sampled seasonally on a monthly basis. Each sampling event will take place over 1-2 days. Sample collection at two backcountry sites will require one technician two days per event. Sampling should also be coordinated with more comprehensive sampling conducted at Happy Isles by the USGS as part of the Hydrologic Benchmark program to provide a quality control check.

Nutrients (dissolved nitrogen species, total phosphorous and total dissolved phosphorous) will be sampled at all sites. Petroleum hydrocarbons will be sampled quarterly at three downstream locations only (Pohono Bridge, Foresta Bridge, and Below Wawona Campground).

Additional petroleum hydrocarbon sampling will take place on a monthly basis during spring runoff sampling. *Escherichia coli* (*E. coli)* bacteria will only be sampled at the eight front-country sites due to the short 6-hour hold time on these samples. All sampling and sample hold times will conform to published USGS and EPA procedures. Storm and spring runoff sampling will be conducted at five sites only, to facilitate delivery and processing of samples at the El Portal Waste Water Treatment Plant. Storm even sampling should take place for each precipitation event that causes a doubling of discharge at the USGS Happy Isles Gage. In the case where a storm follows an extended dry period, one may wish to collect a sample prior to the point at which the discharge has doubled. During large storm events that last many days, two sample sets should be collected as the discharge increases.

At each sampling location, field measurements will also be recorded. These include water and air temperature, pH, specific conductivity, and dissolved oxygen. River stage or discharge will also be recorded where feasible. Nutrients will be sampled at the flow centroid when and where possible. Otherwise, a grab sample taken from the bank where the thalweg is accessible will suffice.

Table B.1.3. Water Quality Sampling Locations for Merced River

Sampling Location [Latitude, Longitude, Elevation, (NAD27 Datum)]	Sampling Schedule
Merced River at Merced Lake, below High Sierra Camp 37° 44' 17'' 119° 25' 07'' 7,200 ft	Monthly between June 15 and October 15
Merced River at top of Nevada Fall (below Little Yosemite Valley 37° 43' 29'' 119° 31' 55'' 5,920 ft	Monthly between June 15 and October 15
Merced River in Yosemite Valley at Happy Isles Gaging Station 37° 43' 54'' 119° 33' 28'' 4,016 ft	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
Merced River in Yosemite Valley at Sentinel Bridge 37° 44' 36'' 119° 35' 20'' 3,950 ft	Monthly
Merced River in Yosemite Valley at Pohono Bridge 37° 43' 01'' 119° 39' 55'' 3,862 ft	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
Merced River in El Portal at SR140 Bridge 37° 40' 17'' 119° 47' 33'' 1,825 ft	Monthly
Merced River in El Portal at Foresta Bridge 37° 40' 10'' 119° 48' 58'' 1,640 ft	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
South Fork Merced River in Wawona at Swinging Bridge 37° 32' 19'' 119° 37' 11'' 4,180 ft	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
South Fork Merced River in Wawona at South Fork Bridge 37° 32' 19'' 119° 39' 28'' 3,950 ft	Monthly
South Fork Merced River in Wawona below Wawona campground 37° 33' 02'' 119° 37' 11'' 3,860 ft	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)

Hydrocarbons and *E. coli* will be sampled as grab samples due to sampling requirements. Field replicates and blanks will be prepared according the requirements for each analyte.

Field staff will properly store and ship water samples within 24 hours or as soon as possible such that the samples remain below 4°C until analysis takes place. All field forms, calibration forms, and chain of custody forms will be photocopied and stored according to protocol. All equipment problems should be documented and addressed immediately.

What follows is a detailed description of monthly sampling. Event sampling is much smaller in scope due to time restrictions. At the end of this section are two Quick Guides to sampling: 1) monthly and 2) event. Once the more detailed information is learned, one can simply take the quick guide to the field as a reference.

Before Going to the Field:

- Confirm with the El Portal Waste Water Treatment Plant laboratory that they will be expecting to receive samples that day. Ideally, all sampling trips should be scheduled at least one month ahead of time.
- Calibrate and check pH, conductivity, and dissolved oxygen (DO) meters according to the calibration methods discussed above. Record this data on the Calibration/Check form and place in binder. Calibrating the conductivity and pH meters once per sample day is sufficient. The DO meters should be calibrated and checked at each sample site. This procedure will be reviewed as sampling progresses to assure proper meter calibration.
- Gather bottle sets, gloves, collection device, meters, forms, cooler, and blue ice. Use at least one blue ice block per sample set to assure the samples remain at or below 4°C.

Sampling Technique Overview: For each site, there should be a designated sampling location. The sample should be representative of the whole river at this location so collect the sample from water moving downstream, possibly in a location where the thalweg impacts the river's edge. Time constraints dictate the collection of a centroid sample (depth-integrated) where possible and a grab sample in other locations. When possible, dual sets of samples (centroid or Equal-Width Interval and grab) should be collected to assess their relative differences.

In general, collect the samples before making field measurements to avoid contamination of the site. Also, when possible, collect samples starting at the most downstream location and working upstream to avoid contamination due to sampling activities. Wear a new set of gloves at each site. Sample upstream of bridges to avoid contamination from the bridge. (Except in the case of Foresta Bridge, where grab samples are more safely collected below the bridge.) For each grab sample, open the bottle and plunge beneath the water surface about 1.0 feet and move the mouth upstream until the container is nearly full. If wading, collect the sample upstream of you. If water depth is less than 1.5 feet deep immerse the sample bottle one third of the depth. Cap the bottle and label properly. Once the samples have been collected, place the pH, conductivity, temperature, and DO probes (or multi-probe) in the water to equilibrate. Take field readings. In order to expedite *E. coli* sample transport to the laboratory and to minimize the potential for contamination, sample processing (acidification, filtration, documentation) should be delayed until back in the laboratory.

Table B.1.4 Sample Processing Requirements

Bottle Number	Analyte(s)	Collection Method	Container	Preservation
1	Dissolved Nitrogen and Phosphorous Species	Grab	125 ml brown plastic (FCC)	Filter within 2-3 hours using 0.45 μm filter; chill to 4°C. Hold time = Ship as soon as possible
2	Total Phosphorous	Grab	125 ml clear plastic (WCA)	Acidify with 1 ml 4.5 N H2SO4; chill to 4°C Hold time = 28 days
3	*E. coli*	Grab	Container provided by lab	Chill to 4°C Hold time = 6 hours
4	Total Petroleum Hydrocarbons	Grab	Baked borosilicate glass 1000ml	Chill to 4°C Hold time = Ship as soon as possible

Specific Tasks for Each Sample Site:

1) Collect *E. coli* sample
2) Collect dissolved nitrogen sample
3) Collect total phosphorous sample
4) Collect total petroleum hydrocarbon sample (at Pohono, Foresta, and below Wawona Campground only) on a quarterly basis. See operational plan.
5) Collect quality control sample(s)
6) Collect field measurements

A. *E. coli* Sampling Protocol (USGS National Field Manual for the Collection of Water-Quality Data (NFM), Chapter 7). Never pre-rinse the sample container. When submerging the sample container, take care to avoid contamination by surface scums. The surface film is enriched with particles and bacteria not representative of the water mass. *E. coli* samples will always be collected as grab samples**.**

1. Establish a consistent sampling location at each site, preferably where there is a consistent downriver current and enough depth to avoid collecting any sediment.
2. For each sample set, wear a new pair of exam (latex, nitrile, vinyl or similar) gloves.
3. Open the sample container and collect a sample from the surface, moving the bottle forward upstream until full. Always hold the mouth of the sample container upstream of the sampler and any disturbed sediments. Avoid contact with the sediment.
4. Place sample immediately in cooler. Fill out sample form.

B. Nutrient Sample - Total Dissolved Nitrogen Sampling Protocol (NFM, Chapter 5.2.1.A):

1. Collect a grab sample at a location where the thalweg impacts the bank.
2. For each sample set, wear a new pair of gloves.
3. Collect sample in a 1-liter Nalgene bottle that had been rinsed 3 times with deionized (not distilled) water. Rinse the bottle 3 times with river water before collecting the sample.

4. Filter the sample using a 0.45 μm filter.
5. Place samples immediately in cooler. Fill out sample form.

(Note that the nitrogen and the phosphorous samples may be derived from the same 1-liter sample)

C. Nutrient Sample - Total Phosphorous Sampling Protocol (NFM, Chapter 5.2.1.A):

1. Collect a grab sample at a location where the thalweg impacts the bank.
2. For each sample set, wear a new pair of gloves.
3. Collect sample in a 1-liter Nalgene bottle that had been rinsed 3 times with deionized (not distilled) water. Rinse the bottle 3 times with river water before collecting the sample.
4. Acidify the sample per directions from the laboratory.
5. Place sample immediately in cooler. Fill out sample form.

(Note that the nitrogen and the phosphorous samples may be derived from the same 1-liter sample)

D. Hydrocarbon/Petroleum Sampling Protocol (NFM, Chapter 5.4.2):

1. Sample at the same location as the *E. coli* sample. This sample will always be collected as a grab sample.
2. For each sample set, wear a new pair of gloves.
3. Open the sample bottle not touching the opening. Do not pre-rinse bottle. Plunge the bottle into the river fully below the surface facing the opening upstream. Move the bottle slowly forward under the surface until nearly full. Leave a small amount of head space.
4. Place sample immediately in cooler. Fill out sample form.

E. Quality Control Samples:

Field Replicate (Collect one replicate per sampling trip).

1. Collect two separate nutrient samples at one location. Rotate sites at which a replicate is collected.
2. Filter or acidify as appropriate.

Field Equipment Blank (Collect one blank per trip).

1. Rinse a sample bottle with DI water 3 times. Fill with DI water. This is the 'blank' nutrient sample.
2. Filter and acidify as if the sample were being processed for nitrogen and phosphorous species.

F. Field Measurements:

Measure temperature (air and water), specific conductivity, pH, and dissolved oxygen (DO). In addition make an estimate of the discharge (NFM Chapter 6). Record all calibration information on calibration forms and place in notebook.

Temperature:

- Measure the temperature at 5-10 cm beneath the water surface, approximately the same location where the samples were collected.
- Report the value to the nearest 0.2 °C.

Specific Conductivity:

- Immerse probe into the water at approximately the same location as where the samples were taken.
- Once it has stabilized, record the specific (temperature compensated) conductivity values to nearest tenth µS/cm.

pH:

- Immerse probe into the water at approximately the same location as where the samples were taken. Agitate the probe continuously.
- Once it has stabilized, record value to the nearest tenth of a pH unit.

Dissolved Oxygen:

- Calibrate the probe at each sample location.
- Immerse probe into the water at approximately the same location as where the samples were taken. Agitate the probe continuously.
- Once it has stabilized, record value to the nearest 0.1 mg/L.

Discharge Estimate:

- At Happy Isles and Pohono Bridge use the USGS gaged flows. Note the time of your site visit and find the discharge later via the USGS web-sites: Happy Isles: http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=11264500&agency_cd=USGS and Pohono Bridge: http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=11266500 &agency_cd=USGS
- At Foresta Bridge, use the wire-weight gage to determine stage. Use the stage-discharge table for this site to determine discharge.
- At Sentinel Bridge, record the stage. No stage-discharge relation yet exists for this gage.
- For the Wawona sites, record the stage on the staff gage across from the golf course. Determine the discharge using the stage-discharge table for this site.

QUICK GUIDE TO VERP WATER QUALITY SAMPLING
(MONTHLY SAMPLING)

Before Field Day:

1) Charge MiniSonde Controller (turn on to assure charging; leave power on)
2) Print and copy on waterproof paper: field forms (12).and calibration forms (3). Make sure you have a chain of custody form (1) and Sampling Log (1). All forms are at MS01/EP Commons/VERP/Field Activities Commons/Water Quality/Forms. Note that some field forms have a back side with reference codes.
3) Assure you have 12 NWQL bottle sets (2 FCC, 1 WCA each), 3 1-L amber bottles, and at least 8 *E. coli* sample bottles. One bottle set is for Merced Lake.
4) Fill 5-gal DI bottle at El Portal Waste Water Treatment Plant (call El Portal Waste Water Treatment Plant @ 379-1828).
5) Verify with Jim Allen (379-1039) that the waste water treatment plant is prepared to receive and process samples.
6) Fill a 1-L bottle with DI water for calibrating the DO when in the field.
7) Assure adequate supply of all calibration and check solutions standards.

Day 1—Main Stem Merced (First Tuesday of the Month):

Before going into field:

1) One person needs to go to Nevada Fall. This person should take the calibrated handheld conductivity meter and a clean 1-L Nalgene bottle to collect the sample. Record the specific conductivity, water temperature, and time of collection. Process back at lab.
2) Assemble 5 *E. coli* sample bottles, 2 TPH brown glass bottles. Prepare cooler with blue ice in which to store 6 1-L bottles each in a zip-lock bag. You may want to prelabel these bottles for each site. One will be a replicate.
3) Clipboard with field forms, chain of custody form, calibration forms, and sample log form.
4) Calibrate multiprobe in laboratory. Calibrate pH (pH 7 and 4, check at pH 5.00), and conductivity (1000 uS/cm and check at 750 uS/cm). **Record all information on calibration form.**
5) Pack large monthly sample bin, DI Water, Hydrolab with cord and controller.

In the field:

1) Calibrate DO. Record on calibration form.
2) Collect grab sample for nutrient analysis. Cap sample bottle, label, and store for processing later. Collect one *E. coli* sample. Collect one TPH sample at specified sites on a quarterly basis. **Record TPH samples on TDI Chain of Custody Form.**
3) Measure pH, water and air temperatures, DO (mg/l), and conductivity at each site. **Fill out field form.**
4) Collect samples indicated in the following table. Following collection of the samples deliver *E. coli* samples to the El Portal Waste Water Treatment Plant.

Site	NWQL Sample	Total Pet Sample	*E. coli* Sample	Measure Stage
Happy Isles	**1**	**0**	**1**	**Online or in field.**
Sentinel Bridge	**1**	**0**	**1**	**Use gage on bridge.**
Pohono Bridge	**1**	**1 (per quarter)**	**1**	**Online or in field.**
SR140 Bridge	**1**	**0**	**1**	**Use same value as Foresta.**
Foresta Bridge	**1**	**1 (per quarter)**	**1**	**Wire weight gage on bridge.**
Replicate (any site)	**1**	**0**		

6) **Fill out the Sampling Log Form as you go.**
7) Back at the lab, process NWQL Samples. Filter the sample for the 2 FCC bottles (125 ml brown bottle). Acidify an unfiltered sample in the WCA (125 ml clear bottle). Rinse bottles three times before filling. Label and chill immediately. **Change filters between samples. On the Field form check the VERP (Schedule 2027) and the alkalinity, pH, and SC analyses.**
8) Process the replicate sample as above.
9) Process one blank sample (use DI water for 2 FCC and 1 WCA).
10) Check the multimeter pH probe using pH 5.00 solution. Check conductivity probe using 750 uS/cm solution. **Record these values and solution temperature on the Calibration Form.**
11) Rinse multimeter. Place a small amount of *tap water* in the calibration cup for storage. Unplug cord and cap conductors for protection.
12) Make copies of all field forms and calibration forms. Verify that each sample bag has the proper field form. Include calibration forms in a separate plastic bag.
13) Store all equipment properly. Rinse all filtering equipment and bottles and allow to air dry before storage.

Day 2—South Fork Merced (First Wednesday of the Month):

Before going to the field:
1) Assemble 3 NWQL bottle sets, 3 *E. coli* sample bottles, 1 TPH brown glass bottle. Place all in cooler with ample blue ice.
2) Clipboard with field forms, chain of custody form, calibration forms, and sample log form.
3) Calibrate the Hydrolab in laboratory. Calibrate pH (pH 7 and 4, check at pH 5.00), and conductivity (1000 uS/cm and check at 750 uS/cm). **Record all information on calibration form.**
4) Pack large monthly sampling bin, DH-81, binoculars, DI water, Hydrolab with cord and controller.

In the field:
1) Calibrate DO. Record on calibration form.
2) Measure pH, water and air temperatures, DO (mg/l), and conductivity at each site.
3) Collect grab sample for nutrient analysis about 100 yards downstream of campground at outlet of large pool. Cap sample bottle, label, and store for processing later. Collect one *E. coli* sample. Collect one TPH sample at specified sites on a quarterly basis (no rinsing). **Record TPH samples on TDI Chain of Custody Form.** Read stage on river near golf course. **Fill out field form.**
4) Collect remaining samples as follows:

Site	NWQL Sample	Total Pet Sample	*E. coli* Sample	Measure Stage
Below Wawona Campground	**1**	**1 (per quarter)**	**1**	**Same as below.**
South Fork Bridge	**1**	**0**	**1**	**Gage in river near golf course (use binoculars).**
Swinging Bridge	**1**	**0**	**1**	**Same as above.**

1) Fill out the Sampling Log Form as you go.
2) Deliver *E. coli* samples to the El Portal Waste Water Treatment Plant.
3) Process NWQL samples back in the laboratory. Filter the sample for the two FCC bottles (125 ml brown bottle). Acidify an unfiltered sample in the WCA (125 ml clear bottle). Rinse bottles three
4) times before filling. Label and chill immediately. **Change filters between samples. On the Field form check the VERP (Schedule 2007) and the alkalinity, pH, and SC analyses.**
5) Ship NWQL samples as soon as possible using overnight FedEx to Dave Clow (forms are in lab). Use plenty of blue ice. Ship TPH samples as soon as possible using overnight FedEx to Dr. Thomas McDonald at TDI Brooks.

QUICK GUIDE TO VERP WATER QUALITY SAMPLING
(EVENT OR SNOWMELT RUNOFF SAMPLING)

1) Weekday: Call the El Portal Waste Water Treatment Plant 379-1828 to tell them you are coming with 5 *E. coli* samples. Tell them approximately what time you will arrive.

   Weekend: Do not collect *E. coli* samples.

2) Gather bottles sets, forms, two coolers, and blue ice:

A. 7 WCA (clear 125 ml bottles + acid)
B. 7 FCC (brown 125 ml bottles)
C. 5 *E. coli* sample bottles
D. 3 amber glass bottles (total petroleum hydrocarbons) + 1 spare in case one is broken
E. Forms: 1 chain of custody TDI form, 1 sample log form, 1 calibration form, 7 field forms (all on waterproof paper)

3) Collect field items:

A. Big black Tuff box : orange vests, towels, lifejacket, grab sample bottles (1-liter) with labels (6), ziplock bags, *E.coli* sample bottles, gloves, conductivity meter
B. One cooler and blue ice for samples
C. Clipboard – all forms, example forms, calibration instructions
D. Binoculars – for the Wawona staff gage by the golf course

4) Calibrate meter – use simple Oakton meter for specific conductivity and temperature only. Calibrate with 1000 uS/cm solution or equivalent and check using 750 uS/cm solution or equivalent.

5) Sample sequence:

A. Swinging Bridge— *E. coli*, FCC, and WCA (collect 2 1-L bottles of river water, 1 sample and 1 replicate)
B. Wawona Campground— *E. coli*, TPH, FCC, and WCA
C. Happy Isles Bridge— *E. coli*, FCC, and WCA
D. Pohono Bridge— *E. coli*, TPH, FCC, and WCA
E. Foresta Bridge— *E. coli*, TPH, FCC, and WCA

[*E. coli* = Sample bottle for *E. coli*, TPH = Total Petroleum Hydrocarbon (1L bottle), FCC = Filtered Chilled (125 ml brown), and WCA = Whole water acidified (125 ml clear)]
For spring runoff sampling, see sampling schedule for which days to sample TPH. It is no longer sampled every week.

6) At each site:

A. Note stage **(try to collect sample at location in main current where it is safe to do so)**
B. Collect *E. coli* sample - (no rinsing!)
C. Collect TPH using 1-L amber bottle— (no rinsing!)
D. Collect one liter of water in plastic bottle for FCC and WCA (rinse 3 times)
E. Label bottles with date, time, sample location
F. Measure temperature, conductivity
G. Finish field form(s)

H. Store samples in cooler

Immediately following collection of last sample at Foresta Bridge, take *E. coli* samples to the El Portal Waste Water Treatment Plant.

7) Back at the lab:

A. Filter samples for FCC bottles
B. Acidify sample for WCA bottles
C. Label all bottles with site name, number, date, time
D. Finish field form
E. Process replicate sample as others, label as such, fill out separate field form, place sample in separate bag
F. Process field equipment blank as others, label as such, fill out separate field form, place sample in separate bag
G. Copy field forms
H. Place original waterproof field forms with their respective samples
I. Check calibration of the meter using 750 uS/cm solution or equivalent
J. Copy calibration form. Place a copy with the samples (in a separate bag). Mail with samples sent to Dave Clow at the USGS.
K. Complete sample log form
L. Refrigerate samples
M. Place all copies of forms in the VERP Drawer at the Rancheria Office.

8) Mail nutrient samples to Dave Clow and total petroleum hydrocarbons to Dr. Thomas McDonald as soon as possible. Send in a cooler with plenty of blue ice. If after 12:00 p.m. on Thursday, mail the following Monday so samples don't sit over the weekend.

Quality Control:

Quality control (QC) of field measurements and sample integrity are outlined in this section. In general, at least one set of QC samples and one set of duplicate field measurements should be taken per sampling trip (one per the eight front-country sites and two back-country sites). In addition, one field blank should be processed per sampling trip.

Sample Replicates (Once per Sampling Trip): For nutrients (nitrogen species and total phosphorous) collect sample replicates at one site per sampling event. Process both samples as normal, labeling one as the replicate sample.

For the *E. coli* sample, a replicate will be prepared in the laboratory. This should be the same sample location as the replicate sample for the other analysis. Standard laboratory positive and negative tests should be reported for each sample batch.

For the total petroleum hydrocarbon sample, the laboratory conducting the analysis will perform quality assurance.

Field Equipment Blanks (One per Trip): Process one sample set using DI water in exactly the same way as a normal river water sample. Rinse a 1 L bottle with DI water three times. Fill with DI water. Fill the total phosphorous bottle from this "sample" bottle. Acidify the sample and store as normal. Filter the "sample" water into a dissolved nitrogen species bottle following normal filtration protocols. Store and label as normal.

Repeated Field Measurements (Once per Trip): Repeat field measurements of temperature, pH, conductivity, and dissolved oxygen once per sampling trip. If taking measurements from a bridge, take the first set of readings as normal. Remove sensors from the water and rinse thoroughly with DI water and return to the same location as the first set of readings. Record these readings in the space provided on the field form.

External Audit Samples: None scheduled at this time.

Equipment Maintenance: The following is a schedule and procedural guide to maintenance of water monitoring field equipment.

Daily (After Sampling):

Buffers and Standards Solutions:

- Store buffers and standards solutions according to manufacturer's directions. Some solutions may have to be refrigerated when not in use.
- Check the expiration dates and order new solutions well in advance. Do not use expired solutions.

Sample Bottles and Collection Devices:

- Rinse all sampling devices (bottles, caps, nozzles, filtering systems, and tubing) with DI water after each sampling day. ***Do not use soap.*** Store in clean zip-lock bags or a clean dust-free container.
- Inspect sampling bottles regularly for scratches or other damage. Do not use bottles that are excessively scratched as these may be difficult to clean.

- Inspect the sampling ports of the DH-81 and DH-95 devices for scratches or damage. Order replacement parts if necessary.

Annually (January or February):

Buffers, Standards Solutions, and Other Chemicals:

- Order sufficient buffer and standards solutions for the coming year. This includes pH 4.00, 7.00, and check solution, and conductivity standard and check solutions.
- Order sufficient acid and methanol.

Sample Bottles and Collection Devices:

- Inspect sampling bottles regularly for scratches or other damage. Do not use bottles that are excessively scratched as these may be difficult to clean.
- Order new sample bottles if necessary.
- Inspect the sampling ports of the DH-81 and DH-95 devices for scratches or damage. Order replacement parts if necessary.

Hydrolab MiniSonde 4a: Follow this schedule for minimum maintenance. This schedule has been developed from the record of instrument performance and consultation with the manufacturer.

After Each Sampling Trip: These are important steps in preventive maintenance that are done each day the instrument is used.

- Post-calibrate the instrument before general cleaning and maintenance.
- Following post-calibration, rinse off the sensors and store them in tap water. Do not use deionized or distilled water for storage.
- Keep the water-tight rubber cable connectors well lubricated and dry on the inside. The best procedure is to store the instrument with all connectors separated and open to the air until dry.
- Check rubber cable connectors regularly to ensure that the mated surfaces are covered with a thin film of white silicone.
- As necessary, use some tissue paper to remove old traces of silicone and dirt and then reapply the silicone.

Before Calibrating: Clean off the sensors. Use a cotton pad and methanol. Cotton swabs or gauze pads are the only materials that will not scratch the soft glass of the pH probes. Paper, including lens paper, is not suitable.

Conductivity: Every two months or once every 15 field trips clean the conductivity sensor with a Q-tip soaked with methanol.

pH: Every two months or once every 15 field trips:

- Wipe the pH probe with a Q-tip soaked in methanol.
- Replace the solution in the pH reference sleeve with a standard electrolyte (3.5 molar KCl saturated with silver chloride).
- Clean the plastic reference probe sleeve and fitted end piece inside and out with a Q-tip soaked in methanol.

- Rinse everything with deionized water before filling and reassembling.
- Always apply a thin layer of silicone to the O-rings.
- When replacing the sleeve, point the sensor down and push the sleeve up until it just covers the O-ring, then point the sensor up and continue to push the sleeve all the way to the base of the probe. This will purge air out of the sleeve and force electrolyte through the Teflon junction.
- Inspect the reference sleeve for air bubbles by observing the sensor while inverting the Sonde. If bubbles are present, repeat the filling procedure.
- Place the instrument sensor upright and fill the reference sleeve with solution until overflowing. As the Teflon junction is screwed in place observe electrolyte coming through.

Every 12 Months:

- Replace Teflon junctions on pH reference sleeve.
- Store spare junctions in a 2 to 5 molar (> 50,000 µmhos/cm) KCl solution.
- Inspect the O-ring at the bottom of the Teflon junction and at the base of the reference sleeve. Replace them if they appear flattened or have small nicks or cuts.

pH Trouble Shooting: If pH still doesn't calibrate correctly, do the following:
Evaluate the condition of the Teflon junction on the terminal end of the pH reference sleeve. The sleeve should slide on easily with some force applied. If the sleeve is difficult to apply, then the junction may have become clogged. In contrast, if the sleeve slides on too easily with little resistance, the junction is too porous. In both instances the junction must be replaced.

If replacing the junction does not solve pH problems, then clean the probe by alternately soaking it in 0.1 N HCl (hydrochloric acid), and then in 0.1 N NaOH (sodium hydroxide) for five minutes in each solution. Use the small black caps that protect display unit terminals to isolate the probes for soaking with these solutions.

Safety Note: Wear safety glasses and gloves when working with the corrosive chemicals.

Batteries: Every two months or once every 15 field trips:
- Review the calibration and replacement schedule for batteries.
- Recharge the 6-volt NiCad Gelcell batteries (nickel-cadmium or nickel-metal hydride) for 12 to 24 hours, regardless of the voltage displayed by the instrument. Ensure that NiCad batteries are recycled or disposed of properly. They should not be put in the regular trash.

Stirrer: Every two months or once every 15 field trips:
- Remove the magnetic metal wheel from the stirrer post.
- Thoroughly clean all lubricant, dirt, and debris from the inside of the wheel and stirrer post with a paper towel and Q-tip.
- Reapply a very small amount of white silicone lubricant to the tip of the stirrer post.

Dissolved Oxygen: Every six months or once every 15 field trips:
- Change the DO membrane and add fresh KCl solution.
- Invert the Sonde on a ring stand.
- Remove the guard, the O-ring, and the membrane. Shake out old electrolyte.

- Rinse DO cavity twice with deionized water and twice with DO electrolyte.
- Fill the cell with DO electrolyte and gently tap the side to release any trapped air bubbles.
- Replace the membrane and secure with the O-ring.
- Inspect the membrane for wrinkles or trapped air bubbles.

Whenever there is anything but a rapid and stable oxygen calibration, replace the membrane as a first step in troubleshooting. The new Teflon membrane is stretched during the replacement procedure. This affects the rate of diffusion for oxygen through the membrane to the internal sensing components. As the membrane relaxes, the rate of diffusion changes in an unpredictable manner. It is preferable to allow the membrane to relax overnight before calibrating. A minimum of 30 minutes must be allowed before the initial calibration.

If the gold cathode ring is discolored or tarnished, polish lightly with a lint free cloth or pencil eraser.

If the white ceramic post in the DO sensor is discolored (ages from white to gray to black):

- Clean with a 1:1 solution of household ammonia and deionized water.
- Remove the membrane from the sensor and pour out the electrolyte.
- Rinse with deionized water. Invert the Sonde on a ring stand and with a small eye dropper fill the cell with the ammonia solution until the white ceramic post is covered. Be careful not to get the solution on the gold anode ring. Have a moist towel close by when conducting this procedure so that the solution can be quickly wiped from the gold ring.
- Let stand for 10 minutes.
- Rinse twice with deionized water and refill according to the standard procedure described above.
- If it is necessary to use the DO probe before the new membrane has 12 ours to relax, carefully recalibrate the dissolved oxygen immediately before each set of measurements.
- **Sonde:** Every 12 months:
  - Replace desiccant inside the display and Sonde units.

B. 1.4 Data Management

Each sampling trip will generate field forms, calibrations forms, and chain-of-custody forms. In addition, there will be laboratory analysis results. All this information must be stored in a convenient and secure manner.

Sample Site Files: Each sample site will have its own folder that will contain site metadata and all field forms. Field forms will likely be required to accompany the samples to the laboratory. Therefore, make copies of each before sending samples.

File the following items in the sample site file:

- Copy of field form
- Copy of the instrument calibration form that corresponds to field measurements taken at that location
- Copy of the corresponding chain-of-custody file(s)
- Copy of laboratory analysis results

These files should be stored in a secure fireproof location.

Instrument Calibration Notebook: All instrument calibration sheets should be stored in a 3-ring binder that is stored in the lab.

Instruments Maintenance Notebook: All notes regarding instruments maintenance should be stored in a 3-ring binder kept in the lab. This binder should be organized by instrument. Notes to be included are battery changes, maintenance performed in-house, and any manufacturer servicing of the devices.

Forms:

1)USGS Field Form (Figures B.1.2 and B.1.3)
2)Instrument Calibration Form (Figure B.1.4)
3)Water Quality Sampling Log (Figure B.1.5)
4)Sample Site Information Form (Figure B.1.6)

Figure B.1.2 USGS Field Form (front)

		Unit (circle)
AHRG Lab number (entered at login)		
SITE INFO		
Site Code (see list)		
Site Name (see list)		
New site (y / n)?	if yes, enter new site info below	
DATE INFO		
Collection date		
Collection time		
Field Filtered?		
If no, date/time filtered		
BULK PRECIPITATION DATA		
Begin date		
Begin time		
Precip volume		L / ml
SNOWPACK OR LAKE DATA		
Sampling depth		ft / in / m / cm
NEW SITE INFO (complete only for new sites)		
Latitude/Longitude		
Elevation		ft / m
Datum, method (GPS, digitizer)		
Accuracy		ft / m
County, State		

FIELD DATA		Units (circle)
Sample Type (see list)		
Sample Method (see list)	If blank, note water lot#	
Sampler (type) (see list)		
Staff gage		ft / in / m / cm
Description		
Tape down		ft / in / m / cm
Description		
Depth of water over weir		ft / in / m / cm
Inner gage		ft / in / m / cm
Discharge		cfs / cms
Air temp.		°C / °F
Water temp.		°C / °F
Field S.C.		µS/cm
Field D.O.		mg/L
Susp. sediment collected?		y / n
If yes, volume filtered		L / ml
PERSONNEL		
Sampling team		
Team leader signature		
Date signed		

BOTTLES	# of each	**Preservation**	**Acid lot**
250 ml FA		filter; acidify in lab (1 ml Ultrex HNO_3)	
250 ml RU		none	
250 ml FU		filter	
125 ml FCC		filter, chill	
60 ml		filter, chill	
125 ml DOC		filter, chill	
15 ml vial (^{18}O)		none	
125 ml WCA		acidify in field (1 ml 5N H_2SO_4)	
Septum (dissolved gas)		none	
Mercury		acidify in field (5 ml Omnitrace HCl)	
1L or 2L RU (circle)		none	

ISOTOPES	Check		Check
^{18}O-water		Tritium	
^{34}S/^{32}S		^{87}Sr/^{86}Sr	
^{35}S		CFCs	
^{15}N-NO_3		^{18}O-NO_3	

PROJECT NAME	**ACCOUNT # (if known)**
VERP	8582-AWR19

ANALYSES	Check
AHRG Lab	
ICP	
IC Anions	
IC Cations	
alkalinity, pH, SC	
DOC	
DON	
NWQL	
HBN (schedule 1671)	
VERP schedule (2027)	
TDN (lab code 2754) (FCC)	
Total N (lab code 2756) (WCA)	
Nitrate (lab code 1979) (FCC)	
Ammonia (lab code 1980) (FCC)	
ortho-P (lab code 1978) (FCC)	
TDP (lab code 2331) (FCC)	
Total P (lab code 2333) (WCA)	
Other (specify lab codes below)	

NOTES

Figure B.1.3 USGS Field Form (back)

Sample Type	Description
S	Streamwater
R	Springwater (eg., talus springs)
G	Groundwater (eg., wells)
B	Bulk precipitation
W	Wet-only precipitation
P	Snowpack
O	Lake Outflow
E	Lake Epilimnion
H	Lake Hypoliminion
F	Field Blank
K	Lab Blank

Site Info	
Site Code	**Site Name**
HB259	Merced River below Merced Lake
HB201	Merced River above Nevada Fall
HB204	Merced River above Happy Isles Bridge
NP182	Merced River above Sentinel Bridge
HB317	Merced River above Pohono Bridge
NP183	Merced River above SR140 Bridge
NP184	Merced River above Foresta Bridge
NP185	S. Fork Merced River above Swinging Bridge
NP186	S. Fork Merced River above South Fork Bridge
NP187	S. Fork Merced River below Wawona Campground

Sample Method	Description
M	Grab
E	EWI
A	Autosampler
R	Replicate
B	Blank
W	Weir
G	Gage
C	Composite
30	Centroid

Sampler Type
(surface water samples)
1L or 2L bottle
DH81
Autosampler
(precipitation samples)
Carboy
Funnel
Aerochem
Shovel/scoop

Figure B.1.4 Instrument Calibration Form

Date: _____
Analysts: _____

Instrument (circle one):

Hydrolab MiniSonde 4a serial# 040900071937

Oakton Con400 serial# 161539

Other:_____

pH

Time _____
1st Level Calibration: **pH 7.0** @ _____°C; Mfr/Lot# _____Exp. Date_____

2nd Level Calibration: **pH 4.0** @ _____°C; Mfr/Lot# _____Exp. Date_____

Calibration Check: (true value) **pH 5.0**; Mfr/Lot# _____Exp. Date_____
Initial Calibration Check (measured): pH _____ @ _____°C
Diff <0.2 units? Cal. accepted by (initials/date/time): _____
Continuing Calibration Check (measured): pH _____ @ _____°C
Diff <0.2 units? Cal. accepted by (initials/date/time): _____

Conductivity

Time _____
1st Level Calibration: **991 µS/cm** @ _____°C; Mfr/Lot#_____Exp.Date_____

Calibration Check: (true value) **717 µS/cm**; Mfr/Lot#_____Exp.Date_____
Initial Calibration Check (measured): _____ µS/cm @ _____°C
Diff <5%? Cal. accepted by (initials/date/time): _____
Continuing Calibration Check (measured): _____ µS/cm @ _____°C
Diff <5%? Cal. accepted by (initials/date/time): _____

Dissolved Oxygen

Calibrations at each site:
Time _____ Barometric Pressure _____ (mm Hg) Temperature _____°C
Time _____ Barometric Pressure _____ (mm Hg) Temperature _____°C
Time _____ Barometric Pressure _____ (mm Hg) Temperature _____°C
Time _____ Barometric Pressure _____ (mm Hg) Temperature _____°C
Time _____ Barometric Pressure _____ (mm Hg) Temperature _____°C

Notes:

Figure B.1.5 Water Quality Sampling Log

Site Name	Site Code	Date	Time	Samples Collected (Number) FCC	WCA	1-L TPH	Fecal Coliform
Merced River Above Happy Isles Gaging Station	HB204						
Merced River Above Sentinel Bridge	NP182						
Merced River Above Pohono Bridge	HB317						
Merced River Above SR140 Bridge	NP183						
Merced River Foresta Bridge	NP184						
S. Fork Merced River Above Swinging Bridge	NP185						
S. Fork Merced River Above SR41 Bridge	NP186						
S. Fork Merced River Below Wawona C.G.	NP187						
FCC - Filtered, Chilled, Integrated							
WCA - Unfiltered, Acidified, Integrated							
1-L TPH - Amber Glass Bottle, Acidified, Total Petroleum Hydrocarbons, Grab Sample							
Fecal Coliform - 100ml Whirl Pak, Grab Sample							

Figure B.1.6 Sample Site Information Form

Site Name: _____
Date: _____

Site Location: UTM _____ E _____N Datum NAD27 NAD83

Lat/Long _____ N _____ W

Site Elevation: _____ meters feet

USGS Site Number: _____

Other Relevant Site Numbers
_____

Site Description:

Sketch Map:

Data entry: As soon as is feasible, a record of the sampling event should be recorded in the VERP water quality database. Enter one new record for each sample location as well as one record for the duplicate sample and one record for the field blank. Once laboratory data becomes available, this too should be entered into these records.

Data analysis: Data analysis consists of first checking data against all hard copy field forms and laboratory results. Once this is complete, data should be censored to exclude duplicates, blanks, and values below detection limits. For each site, prepare a summary plot of all concentrations of each analyte (total dissolved nitrogen, nitrate plus nitrite, total dissolved phosphorous, total phosphorous, E. coli, and total petroleum hydrocarbon) or report in the form of a table. Summary statistics (mean, standard deviation, maximum, and minimum) should be prepared for field parameters such as water temperature, specific conductivity, pH, and dissolved oxygen. This summary data will be reported as a part of the VERP Annual Report. In the annual report, notable findings should be mentioned as well as any exceedances of existing water quality standards.

B.1.5 Personnel Requirements and Training

Roles and Responsibilities (tasks and time commitments): Yosemite National Park, through the Division of Resource Management and Science will be responsible for the administration of this monitoring plan. Management of this project will be conducted by the branch chief of Physical Sciences and GIS within the division of Resources Management and Science. Responsibilities are:

- Preparation of an annual implementation plan and budget
- Training of field personnel
- Purchase and maintenance of field equipment
- Review of data and procedures
- Maintenance of data, field forms, equipment repair and maintenance logs, and updating protocols

Preparation of an Annual Implementation Plan and Budget: The annual plan should include a sampling schedule, the laboratory(s) used, anticipated personnel needs and time. There should be a comprehensive list of equipment, repair or calibration needs, and a list of disposables such as calibration and check solutions. A budget should be included. If possible, there should also be a summary of the previous season's problems and possible solutions. This plan provides a record of data gathering activities.

As each new or returning technician enters on duty, they should receive comprehensive training on field and office water sampling procedures. The project manager should document this training for each technician for each season.

The project manager or a designated technician should be responsible for ordering new equipment and consumables, repairing or calibrating existing equipment (beyond routine actions), maintaining a supply of fresh buffers and calibration solutions, and maintaining a log of all equipment repairs.

Every couple of months, the project manager should review the laboratory data and the QC sample data in particular. This information, coupled with discussions with field staff, should be used to review or modify procedures to improve data quality.

All field data forms should be photocopied and stored as office copies or archive copies. Office copies are photocopies of the originals and are intended as an operational reference. Original data forms, chain-of-custody forms, and calibration forms should be stored as archives in a fire-safe location. Each instrument should have a logbook to document calibrations, repairs, and factory calibrations. As sampling protocols are modified, former protocols should be archived with the dates that they were in effect.

Training procedures: Each technician collecting water samples and field data associated with this project must have demonstrated the following:

- The ability to calibrate and operate conductivity, pH, and dissolved oxygen (DO) meters.
- Proper sample collection, preservation, and handling.
- A safety conscious approach to field work around rivers.
- Knowledge of proper documentation procedures.

These skills may be verified through assisting a qualified technician or by a means deemed satisfactory to the branch chief for Physical Sciences and GIS. This training should be documented at least once a year for each technician.

B.1.6 Operational Requirements

Work plan: Monthly sampling will be conducted on the first Tuesday and Wednesday of the month except December and February. Event samples should be collected as soon as is feasible. Spring runoff samples are to be collected weekly for a period of 8-10 weeks following that start of spring runoff.

Safety: A job hazard analysis (JHA) has been completed**.** See job hazard analysis table below (Table B.1.6).

Table B.1.5 Job Hazard Analysis for Water Quality Data Collection

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Water Quality Sampling	Main Stem and South Fork Merced River	
Job Hazard Analysis (JHA)	**3. NAME OF ANALYST**	**4. JOB TITLE**	**5. DATE PREPARED**
	Laura Clor	Technician	April, 2005
6. TASKS/PROCEDURES	**7. HAZARDS**	**8. ABATEMENTS ACTIONS** ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Using bridge board and leaning out over bridge railings to lower/retrieve sampler.	b. Back injury due to lifting heavy DH-95 sampler, falling from bridges into water, injury due to loss of control of bridge board as heavy sampler drops from bridge into a suspended position.	b. Use proper lifting techniques to prevent back strain, employ a second person to aid in lifting or to serve as a spotter for the lifter, a third person should stand on the bridge board foot pegs to anchor it firmly to the ground.	
c. Carrying DH-95 sampling device to and from bridge locations.	c. Back strain or other injury.	c. Stop to rest, lift with legs rather than back, use two people to carry for longer distances.	
d. Working on bridges.	d. Accidents and injury resulting from being hit by a car.	d. Wear orange safety vests, be cautious of traffic.	
e. Wading in river to collect samples.	e. Tripping, falling or being swept away due to slippery, uneven river bottom surfaces and strong currents.	e. Use extreme caution in watching footing, wear life vest, only wade if the water level/current strength is low enough to permit it, collect sample from river edge if water is too high and/or swift.	
f. Working and walking along riverbanks.	f. Tripping and/or falling due to wet and slippery rocks or sloping ground surfaces, contact with poison oak, etc.	f. Watch footing, know how to identify and avoid all poison oak, rinse immediately in stream if contact occurs.	
g. Acidifying water samples with sulfuric acid.	g. Skin or eye contact resulting in irritation, rashes or chemical burns.	g. Use dropper bottle to minimize potential for contact, acidify samples at counter level, rather than holding up to eye level, flush immediately in lab sink if contact occurs.	
h. Working outdoors in cold and/or wet weather.	h. Hypothermia, reduced resistance to illness.	h. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
10. SUPERVISORS SIGNATURE	**11. TITLE**	**12. DATE**	

Equipment and materials: All equipment and materials are stored with the Branch of Physical Sciences and GIS. The lead technician and the park hydrologist are responsible for making sure that adequate supplies are available and in working order prior to each sample event.

Budget: The budget for fiscal year 2006 is a combination of USGS and NPS funds. NPS funds cover routine sampling, processing, data entry, and program administration. USGS funds cover most of the analytical costs as well as additional monitoring and program oversight by USGS Research Hydrologist David Clow.

	USGS Estimated Expenses	NPS Estimated Expenses
PERSONNEL		
Research Hydrologist, USGS	$14,981.55	
Hydrologist - NPS		
Physical Science Technicians, GS-05, 680 hours		$10,880.00
Physical Science Technicians, GS-06, 240 hours		$4,303.20
MATERIALS		
Supplies	$2,583.03	$1,500.00
Equipment	$8,265.68	$1,500.00
Services	$2,583.03	
ANALYTICAL		
Nutrients	$19,657.30	
E. coli		$850.00
Total Petroleum Hydrocarbons		$5,502.00
DNA source tracking, TPH fingerprinting, caffeine analyses	$6,125.00	
TRANSPORTATION/TRAVEL	$3,616.24	$1,500.00
TOTAL COSTS	$57,811.82	$26,035.20

B.1.7 References:

Clesceri L.S., Greenberg A.E., and Eaton A.D. Editors (1998). Standard Methods for the Examination of Water and Wastewater (20th Edition). American Public Health Association, the American Water Works Association, and the Water Environment Federation.

National Park Service- Freshwater Workgroup Subcommittee (2002). Recommendations for core water quality monitoring parameters and other key elements of the NPS Vital Signs program, water quality monitoring component. Fort Collins, CO, National Park Service.

United States Geological Survey, variously dated, National Field Manual for the Collection of Water Quality data: United States Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9, available online at: http://pubs.water.usgs.gov/twri9A.

B. 2. Riverbank Erosion

B.2.1. Background

Riverbank erosion has been selected as an indicator because soils and the vegetation that stabilizes them are integral to the integrity of riparian ecosystems. Although soil erosion occurs along the river as a result of natural river processes, such erosion can be accelerated and exacerbated by visitor use. Increasing visitor use on susceptible substrates often results in increased soil erosion. Therefore, this indicator is valuable for assessing a site's ability to sustain varying types and levels of visitor use.

Riverside soils and vegetation affect water quality by regulating the entry of groundwater, surface runoff, nutrients, sediments and other particulates, and fine and coarse organic matter to rivers and streams. Accelerated erosion associated with trampling and visitor access can alter these processes, leading to changes in hydrology and water quality.

In addition to indicating loss of soil, erosion may affect cultural Outstandingly Remarkable Values. The amount of riverbank erosion associated with visitor use will be used as an indicator of changes that may be occurring to any cultural resources—namely to archeological sites—that may exist along the river corridor. Riverbank soil erosion that occurs at archeological sites would suggest a potential loss of site stability and loss of intact archeological artifacts and features, critical components of archeological site integrity. Once artifacts and features are displaced from their original context or lost, the information inherent to those deposits is also lost.

Description of indicator and standard
Indicator: Degree of riverbank erosion along the Merced River. This will be assessed through a combination of vegetative cover condition and substrate erosion condition characteristics, resulting in determination of Riverbank Condition Index (RCI) values, as well as thorough surveys of river and riverbank morphology and riparian vegetation analysis.
Standard: No net increase over baseline (from 2005 inventory) in linear extent of riverbank erosion that is accelerated or caused by visitor use. A range of RCI threshold values will be developed through consultation with professionals specializing in ecology and river geomorphology. The resulting standard will vary by management zone depending on desired conditions designed to protect Wild and Scenic ORV's for individual zones.
Zone(s): 2B Discovery, 2C Day Use

Rationale for indicator: Vegetation and erosion conditions of the banks of the Merced River will be monitored because the conditions of riverbanks are an important indicator of potential impacts to Outstandingly Remarkable Values of the river corridor.

Objectives: To document the extent of human-caused riverbank erosion along the Merced River in Yosemite Valley by assessing bank and river morphological characteristics, erosion features, riparian vegetation condition, and human use impact. Through comparison of existing conditions to standards, problem areas can be identified and management actions, such as restoration or access limitations, can be taken to ameliorate riverbank erosion impacts to the Merced River ecosystem.

B.2.2. Sampling Design

Rationale for sampling design: The Riverbank Erosion indicator is designed to monitor human-caused riverbank erosion in Yosemite Valley via a multi-faceted approach. Since the potential for riverbank erosion is a product of both substrate stability characteristics and vegetative cover, both of these factors are addressed in this protocol. A complete inventory of riverbank erosion condition along the Merced

River as it flows through Yosemite Valley was conducted in 2005 by Resources Management and Science staff walking both banks of the river from the Happy Isles Gauging Station in the East Valley to Cascades Dam in the West

Valley. A total of 10 river miles were surveyed. Monitoring was conducted using a *segmental evaluation* approach, whereby the bank on each side of the river was divided into *100-meter* contiguous segments with an assessment resolution level of 10m. An erosion condition class assessment and a vegetation condition assessment were conducted for each 10m segment. Each 100m segment was attributed with an overall RCI Value. Such an inventory will be repeated every 5 to 10 years. Field work in the 2006 season will mark the beginning of annual monitoring of a sub-sample of the riverbank segments. This monitoring will consist of a dual-level sampling scheme, with the establishment of (1) permanent monitoring sites to establish consistent long-term monitoring and (2) randomly selected rapid assessment plots to address proliferation of riverbank erosion impacts along the corridor. The purpose of establishing permanent monitoring stations is to provide a more accurate baseline against which future changes in riverbank condition at these stations can be compared. The selection of these stations is based on their representation of river regimes, influence of visitor use, and other monitoring data on those sites.

Measurement: Two sampling strategies will be used to measure riverbank erosion:

1) Permanent monitoring sites- A thorough and technical assessment of river geomorphology/bank structure and riparian vegetation will be conducted at these sites. Total station surveying equipment will be utilized to obtain cross- and longitudinal-sections, resulting in high-accuracy graphical depictions of both types of profiles at the individual river segments. Photopoints will be established to document visual changes in river and bank morphology over time. Riparian vegetation will be assessed following a protocol adopted from Winward 2000 and Herrick et al. 2005. Pebble counts will be executed following the Wolman method to characterize substrate type.
2) Rapid assessment plots- These plots will be assessed using methods employed in 2005. Riverbank erosion will be assessed using two metrics: (1) vegetation condition rating and (2) erosion condition rating. Ratings for each metric are based on Likert scale and vary from 1 to 4, with lower condition ratings indicating a lower level of vegetation impact and erosion, and higher condition ratings indicating a higher level of vegetation impact and erosion. A Riverbank Condition Index (RCI) was developed and will be used to integrate erosion and vegetation condition information into a single composite index. Other attributes that contribute to the degree of riverbank erosion will also be recorded, including type/slope of riverbank, substrate type, and existence of human impact.

Site selection (selection criteria and procedures): Site selection for the 2006 field season will vary by sampling scheme:

1) Permanent monitoring sites- These will be established in areas of concern identified by the 2005 inventory, existing or future restoration areas, sites overlapping with other VERP indicators, pre-existing monitoring locations, and/or reference areas exhibiting minimal riverbank erosion caused or accelerated by visitor use: the goal is to achieve a representative sample of high and low use sites. In 2006, three river segments were selected to pilot this methodology: Pines Campgrounds, Sentinel Beach, and El Capitan Picnic Area Restoration Site. The Pines Campgrounds segment was chosen due to overlap with existing river cross-section monitoring locations and the presence of extreme human-induced erosion. Sentinel Beach was chosen because of overlap with VERP PAOT monitoring and the presence of moderate amounts of human-induced erosion. The El Capitan Picnic Area Restoration Site was chosen because it exhibited relatively low levels of visitor-induced erosion, it is the site of past ecological restoration work, and it has pre-existing river cross-section monitoring locations. Each 2006 segment will be approximately 200m in length (each encompassing at least two segments from the 2005 inventory) and span the width of the river and its banks to encompass the transition from riparian to upland vegetation communities.
2) Rapid Assessment Plots- In 2006, rapid assessments (100m linear plots) will be conducted at permanent plots, and there will be approximately three rapid assessment plots per permanent

assessment reach (each permanent assessment reach was approximately three hundred meters in length). In the future, these plots will be randomly selected from the 2005 inventory of 100m riverbank segments and will provide a representative sample with which to assess the overall health of the Merced River corridor in Yosemite Valley.

Sampling Schedule: Field work for this indicator will be conducted in mid-August to mid-September, depending on accessibility due to river level.

B.2.3 Field Methods

Preparation: Field personnel should be trained (see Training, below) and the following required tools and supplies should be acquired.

- Map with location/directions to target sites (magnified from 2005 GIS map)
- Map identifying known archeological sites in proximity to target sites
- Compass
- Radio
- Meter tape
- Chaining pin (stake for pinning meter tape)
- Flagging
- Gravelometer
- Total station, including tripod, rod and reflector, charged data collector and connection cable, batteries
- Plant press
- Plant identification keys
- Trowel
- Metal detector
- Maps to permanent monuments
- PDA handheld device
- Camera (with archival quality slide film)
- USGS quadrangle enlargements
- Field Forms: Data sheets and photo-documentation forms on waterproof paper
- Clipboard/pencils
- Copy of Riverbank Erosion VERP monitoring protocol on waterproof paper
- Water and food
- Sunscreen
- Water sandals
- GPS handheld (Trimble GeoXT)

  * Usage of GPS devices in Yosemite Valley often poses a challenge because the dramatic topography prevents acquisition of sufficient satellite signals for proper functioning of the units. In 2005 monitoring, GPS was not employed due to these issues, and the need for rapid assessment of the entire Merced River corridor in Yosemite Valley prevented field staff from investing the significant amount of time needed to wait for satellite acquisition. Given that 2006 monitoring will entail intensive field work at fewer locations, there may be sufficient time for acquiring satellites at sampling sites. GPS documentation of sites should be performed where possible.

Data collection: Data collection for permanent sites and rapid assessment plots will differ. Therefore, their methods are described separately below:

1) Permanent monitoring sites:

Locate monitoring site using 2005 GIS map and meter tape:
GPS the four corners of the site for permanent plots and the up- and down-river boundaries for rapid assessment plots. These points should also be surveyed with the total station to increase accuracy. Survey from established benchmarks where possible.

Setting Up Transects:

Cross-sectional Transects (CST)

Four or five CSTs are to be established at each monitoring station, depending on the presence of pre-existing monitoring cross-sections. Each CST extends between opposite banks perpendicular to the

direction of channel. A permanent monument beyond the riparian zone will mark the end of the CST on each bank. These monuments are to be GPS-mapped and referenced using nearby permanent features.

Longitudinal Transects (LGT)

A total of five LGTs are to be established at each monitoring station. Four **bank LGTs** are situated on the river banks parallel to the direction of channel, with two LGTs on each side representing the lower bank (toe of slope, where riverbed transitions into bank) and upper bank (the upper edge of riparian vegetation/top of bank). The fifth LGT follows the **thalweg,** the lowest points of the channel bottom where river flow is the fastest. The LGTs should be perpendicular to the CSTs, parallel to the direction of river flow, and it should maintain similar distance from the active water level. Colored flags can be used to define each LGT if needed.

Detailed procedures for permanent plots:

1. Photographic Documentation

The permanent monuments that mark the ends of the CSTs are also used as permanent photopoints (using protocol established by Louise Johnson 1990) used to document environmental changes. The exact locations of permanent monuments (established with rebar and survey caps) are recorded with GPS and hand-drawn maps. The maps incorporate the distance and azimuth to natural or artificial reference points (rock, big tree, trail sign, foot/road bridge, etc.). Two photos are taken across the CST, one each to the corresponding monument on the other bank. Another four photos are taken from the middle of the river, pointing upstream, downstream, and to each monument. Photos will be exposed as slides and stored in the slide archives of the Branch of Vegetation and Restoration.

2. Profile Survey

The profile survey procedures for CSTs and the LGT are based on Harrelson et al. (1994), Section 6 (pp. 26-32) and Section 8 (pp. 37-41). Please refer to the reference for surveying basics. If using total station surveying equipment, survey data (such as in the examples depicted below) may not be necessary. Below are concise steps for CST and LGT, respectively:

Cross-Sectional Profile (CST)

- Figures B.2.1 and B.2.2 provide a graphical representation and sample data of a CST.
- Establish the benchmark to set up elevation and survey controls. Existing benchmarks or permanent natural or artificial features can be used if available. Record the exact location of each endpoint (permanent marker) based on its distance and direction to the corresponding benchmark. Draw a site map to indicate location of benchmark, endpoints, and other important features and record measurements.
- Set up a taut tape across the cross section, with zero-end of the tape to the end point where elevation measurements will be taken. Starting on the left side of river is suggested for easier plotting of profiles later.
- Begin the total station survey. Be sure to record the correct height of the survey rod. Start with the endpoint stake as zero. Begin shooting points with the total station. Along the tape

(cross-section), shoot a point at each change in elevation and at each important feature, on all slope breaks and at the edge of water.

- Total station data should be downloaded upon return to office.

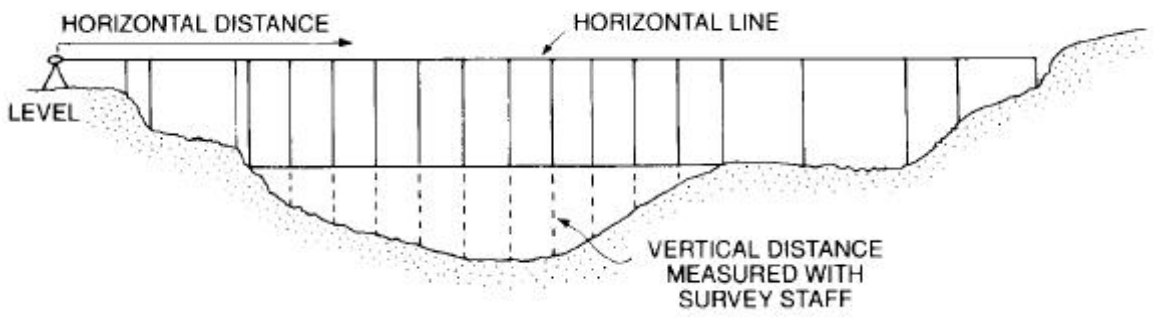


Figure B.2.1. Diagram of a cross-section survey (Harrelson et al. 1994).

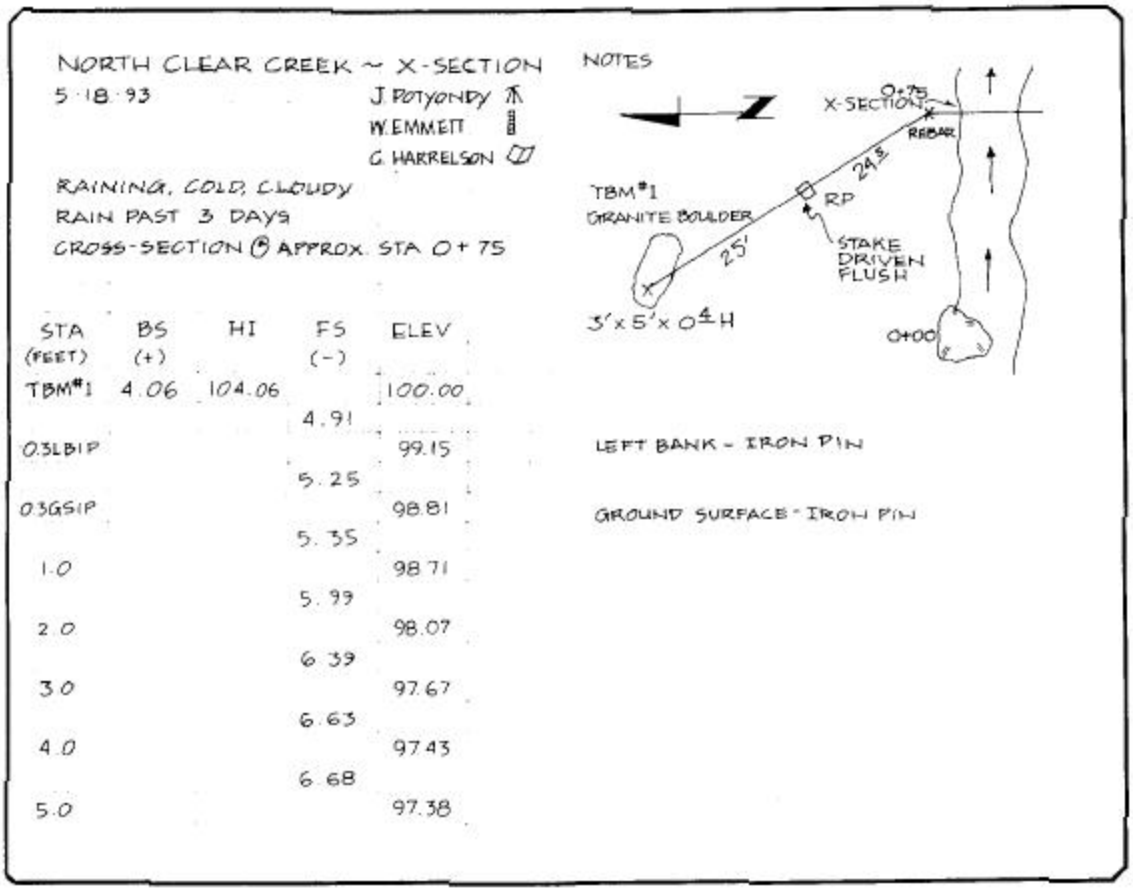


Figure B.2.2. Sample notes for cross-section survey (Harrelson et al. 1994).

Longitudinal Profile

- Figure B.2.3 and B.2.4 provide a graphical representation and sample data of a LGT.
- Set up the total station so that the benchmark and most of the profile is visible.
- From the total station, move the survey rod along the longitudinal transect (toe and top of bank on each side and thalweg), and take points at the major features described in the preceding section (or every 5m, whichever is closest).

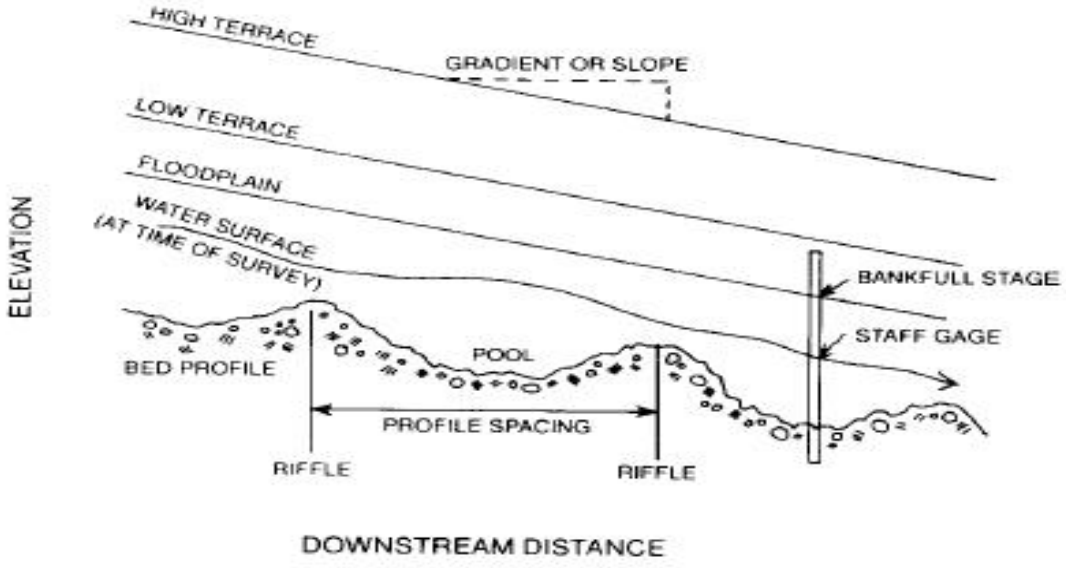
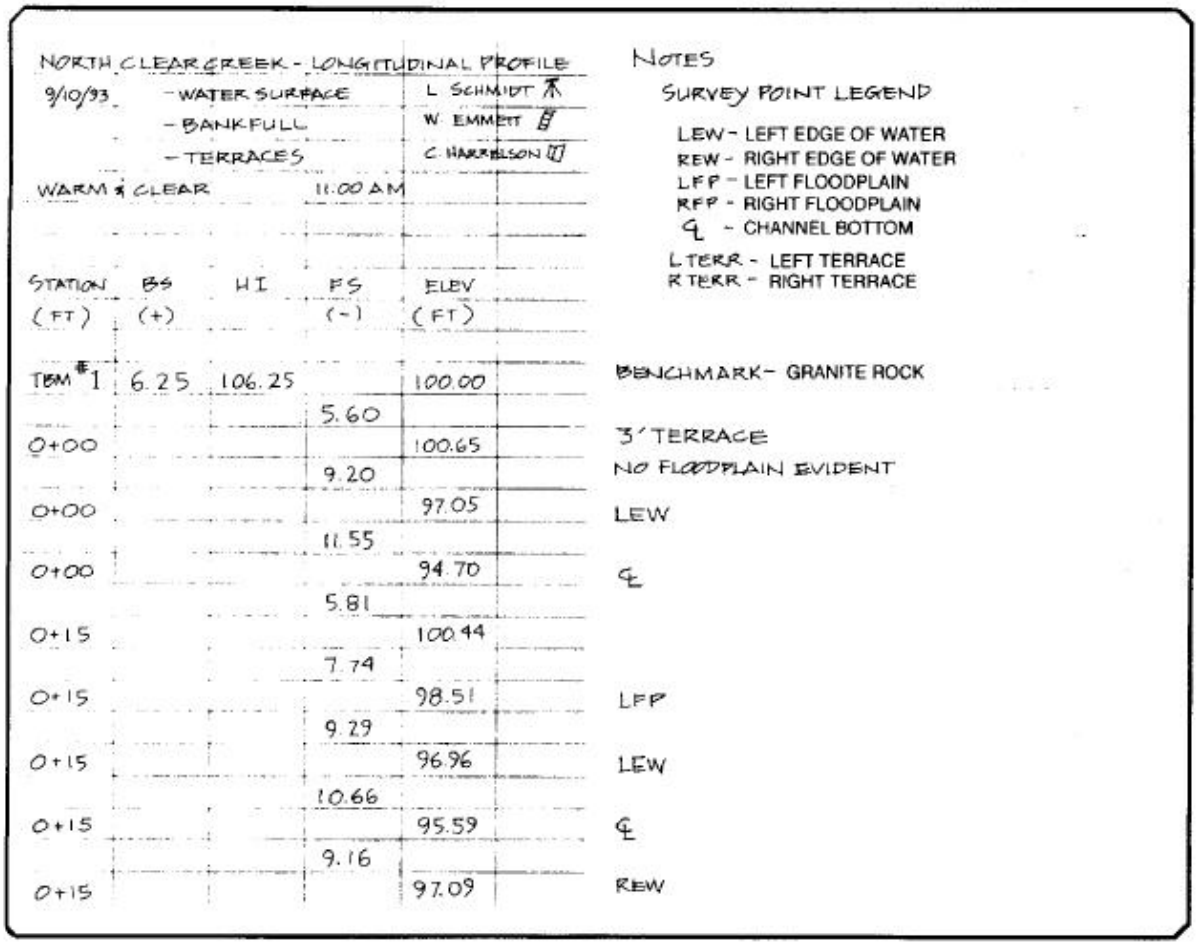


Figure B.2.3. Typical layout of longitudinal profile (Harrelson et al. 1994).



NORTH CLEAR CREEK - LONGITUDINAL PROFILE
9/10/93 - WATER SURFACE
- BANKFULL
- TERRACES
L SCHMIDT
W EMMETT
C HARRELSON
WARM & CLEAR 11:00 AM

STATION (FT)	BS (+)	HI	FS (-)	ELEV (FT)
TBM #1	6.25	106.25		100.00
			5.60	
0+00				100.65
			9.20	
0+00				97.05
			11.55	
0+00				94.70
			5.81	
0+15				100.44
			7.74	
0+15				98.51
			9.29	
0+15				96.96
			10.66	
0+15				95.59
			9.16	
0+15				97.09

NOTES

SURVEY POINT LEGEND

LEW - LEFT EDGE OF WATER
REW - RIGHT EDGE OF WATER
LFP - LEFT FLOODPLAIN
RFP - RIGHT FLOODPLAIN
℄ - CHANNEL BOTTOM
L TERR - LEFT TERRACE
R TERR - RIGHT TERRACE

BENCHMARK - GRANITE ROCK

3' TERRACE
NO FLOODPLAIN EVIDENT

LEW

℄

LFP

LEW

℄

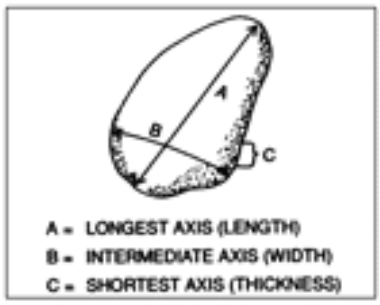
REW

Figure B.2.4. Sample notes for longitudinal profile (Harrelson et al. 1994).

3. Pebble Count

This Pebble Count procedure is performed along each CST and is based on the Wolman method (Bevenger and King 1995; Kershner et al. 2004). At least 100 pebbles should be sampled for each monitoring station. The procedure involves four main steps:

- Start on the lower bank of CST. Take one step toward river perpendicular to the flow. Close the eyes and pick up the first pebble touching the index finger. If there is no pebble move another step toward the river.
- Measure the intermediate or b axis (see diagram) of the pebble using a measuring tape or gravelometer and record the length. DO NOT measure the longest axis or the shortest axis.
- Repeat the above step across the river channel, stopping at the opposite lower bank.



WOLMAN PEBBLE COUNT MEASUREMENT

Yosemite National Park

National Park Service
U.S. Department of the Interior

Pebble Count Form

Date:____/____/_____(mm/dd/yyyy) Time:____:____(24hr) Weather:_____
Field Staff:_____
Reach name or number: _____Location: Transect Type: Cross-sectional/Longitudinal (Circle One)

Cross-Section Number	<4 mm	≥4<8 mm	≥8<16 mm	≥16<32 mm	≥32<64 mm	≥64<128 mm	≥128<256 mm	≥256<512 mm	≥512 mm

Measure at least 100 clasts per cross-section. Complete entire cross-sections (one full cross-section if greater than 100 clasts are sampled; two or more complete cross-sections if one cross-section has less than 100 sampled clasts).

Comments:

4. Large Woody Debris

LWD is defined as sticks and logs that are over 1 m in length and at least 10 cm in diameter at one end (Davis et al. 2001). Along each CST and LGT, shoot a point with a total station at any LWD encountered and record its size class. LWD1 is 1 m to 5 m long, LWD 2 greater than 5 m to 10 m long, and LWD 3 is greater than 10 m long.

5*. Vegetation Community Characterization*

Vegetation assessments will be conducted along river cross-sectional transects in order to capture the gradient of vegetation communities from the river channel to the top of bank (protocol adapted from Winward 2000). This will be accomplished using a transect (Herrick et al. 2005) with the following parameters (see Figure B.2.5):

- Stretch meter tape taut between monuments
- First and last sampling sites will be located with the downhill plot edge at the toe of bank and top of bank, respectively
- Sampling sites will be located every five meters between the toe and top of bank.
- Each plot will be centered on the transect
- Assess vegetation via three structural categories (herb, shrub, tree) using the following plot sizes:
  - Herb layer: 1m² quadrat
  - Shrub layer: 5m x 5m belt transect
  - Tree layer: 20m x 5m belt transect

Vegetation should be identified to species when possible. If identification is precluded (e.g. due to phenology, which is often the case with sedges and willows), results can be recorded using the following functional classes (Chambers and Brown 1983) and annotated with common name (e.g. willow, sedge, etc.):

GA - Grass, annual
GP - Grass, perennial
HA - Herb, annual/biennial
HP - Herb, perennial
SB - Shrub, broadleaf
SN - Shrub, needleleaf
TB - Tree, broadleaf
TN - Tree, needleleaf
LM - Lichens and mosses

- Assess the following vegetation characteristics for each structural category:
  - Herb layer: [1]cover class per species
  - Shrub layer: [1]cover class per species
  - Tree layer: [2]DBH class and [3]height class of each individual, indicate whether or not [4]significant root exposure is occurring

General notes:

- Species identification: This is most important for non-upland plots. Upland species can be identified to functional group (e.g. annual grass, perennial grass, etc.). Identify to species, if possible.
- Record *Salix* spp. (no need to identify species) in shrub layer and *Alnus* spp. in tree layer
- Tree seedlings should be counted in the tree layer

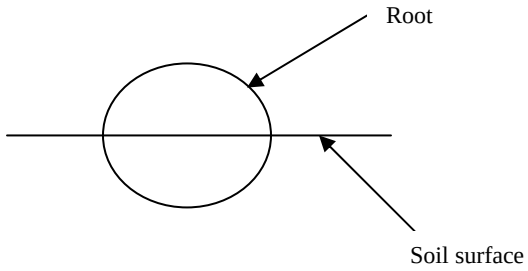
[1] Modified Daubenmeyer cover class scale:
0…….0
1…….1-4%

2…….5-24%
3…….25-49%
4…….50-74%
5…….75-94%
6…….95-100%

[2] DBH classes:
1…….0-5cm
2…….5-20cm
3…….20-50cm
4…….50-100cm
5…….>100cm

[3] Height classes:
1……..<2m
2……..2-5m
3……..5-10m
4……..10-20m
5……..>20m

[4] Significant root exposure: >50% of the diameter exposed of any root in the tree layer plot.



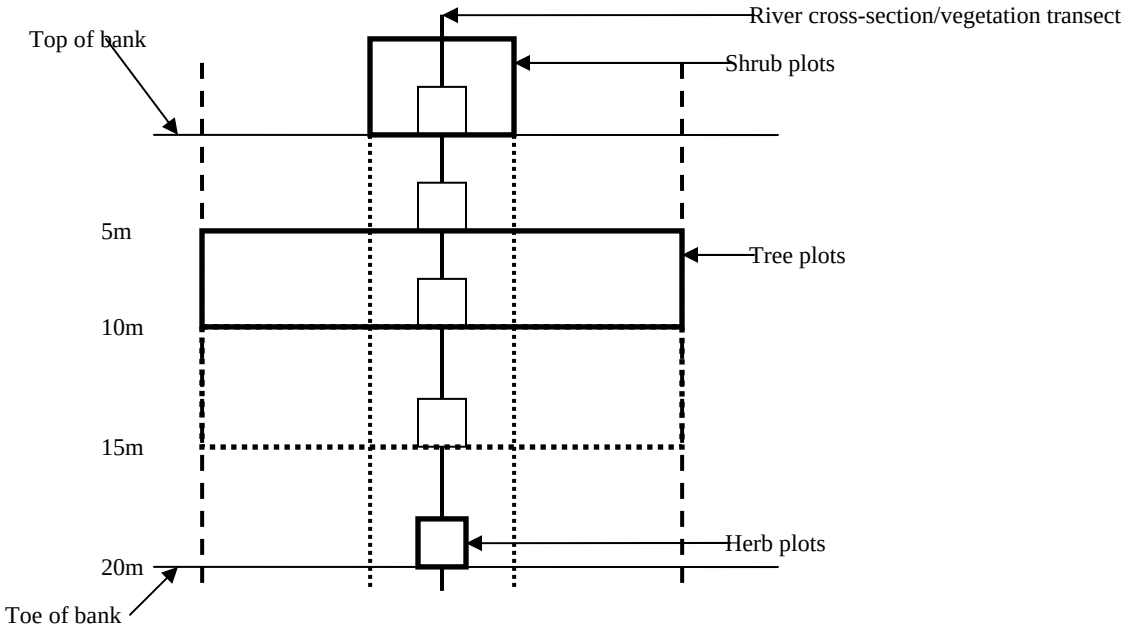


Figure B.2.5 Vegetation transect design, including relative sizes of plots for the three different vegetation types and their orientation on the cross-sectional transect.

Figure B.2.6 Vegetation assessment datasheet for recording the presence of shrub and herb species.

Vegetation assessment datasheets:

VERP 2006 Riverbank Erosion: Riparian Vegetation Assessment – Shrub and Herb layers			Date:
Site:		Observers:	
River cross-section:	R or L bank		Shrub or Herb (circle one)
Daubenmeyer cover class scale: 0…….0 1…….1-4% 2…….5-24% 3…….25-49% 4…….50-74% 5…….75-94% 6…….95-100%	Tape strung from L or R bank Notes:		

	Sampling Site Distance (must have top and toe of slope, intermediate sampling sites are 5m apart)																				
Species																					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PARK
SERVICE

Figure B.2.7 Vegetation Assessment Datasheet for Tree Species

VERP 2006 Riverbank Erosion: Riparian Vegetation Assessment - Tree layer		Date:
Site:	Observers:	
River cross-section:		R or L bank (circle)
DBH classes (D): 1…….0-5cm 2…….5-20cm 3…….20-50cm 4…….50-100cm 5…….>100cm	Height classes (H): 1……..<2m 2……..2-5m 3……..5-10m 4……..10-20m 5……..>20m	Sampling site: / Tape strung from L or R bank Significant Root Exposure: Yes or No (circle) Describe if present:

	Characteristics of each individual																													
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
Species	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H
	16		17		18		19		20		21		22		23		24		25		26		27		28		29		30	
Species (cont'd)	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H	D	H

6. Extent/Evidence of Human Use
The intent of this parameter is to assess the extent of human use through overlap with People at One Time (degree of visitor use) monitoring efforts, as well as through documentation of human use impacts through GPS mapping of social trails and disturbed areas. This parameter will not be evaluated in detail during permanent site assessments in 2006 since it is addressed to a certain degree in the Rapid Assessment protocol, and Rapid Assessments had complete overlap with permanent sites this field season. In subsequent field seasons, however, when rapid assessments and permanent site assessments may be conducted in different locations, there will be the more substantial investigations of human use at permanent monitoring sites as described above.

However, in 2006, the Sentinel Beach Picnic Area monitoring site was also a monitoring site for the People At One Time indicator, and so data collection efforts from these two indicators will complement each other at that site. The intent is for monitoring efforts of these two indicators to overlap to a greater degree in subsequent years with the addition of more sites.

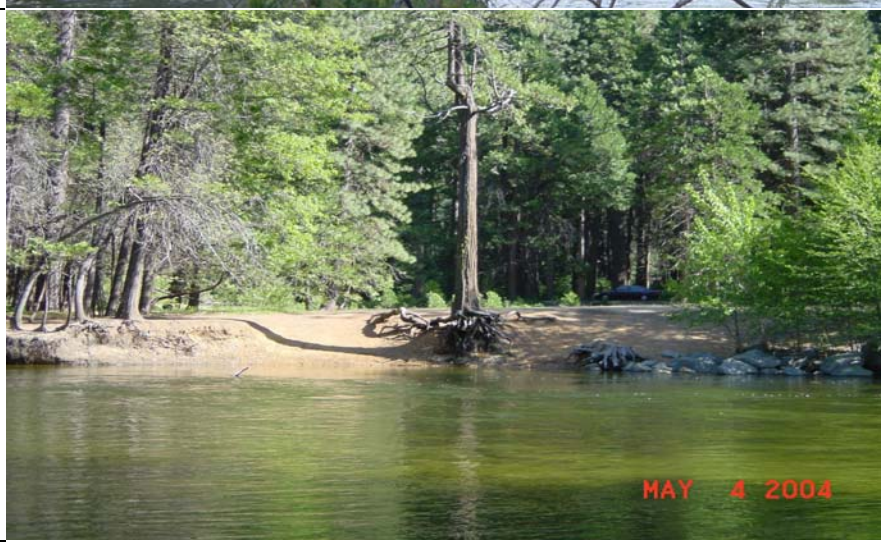
Detailed procedures for rapid assessment plots:

- Locate selected 100m segment using 2005 GIS map and meter tape. Leave meter tape unfurled, and use it as a guide for conducting assessment. Assessment should be conducted at the normal high water mark, which is the highest water level reached in an average year (this is most often where the riparian vegetation stops and the conifer terrace begins). The goal is to document environmental and impact attributes described within the riparian zone between current water line and the edge of riparian vegetation. In the event that no 'edge of riparian vegetation' is present because of human structure (e.g. roads) the riparian zone can be defined as *10 meters* from the current water line.
- Fill out preliminary datasheet information:
  Date: Day/Month/Year (August 8, 2004 = 08/08/04) of survey
  Field staff: Record name of field monitor(s)

- For each 10m section within the 100m segment, record the segment number, and determine the type of slope, substrate type, vegetation condition rating, and erosion condition rating (see descriptions below). Use tally marks to keep track of how many of these 10m sections fall into vegetation condition class 2, for example. When the 100m segment is completed, translate this into a percentage (will be to 10% for each class) and record in proper location on the data sheet. Exclude bridges from assessment (e.g. if a bridge comprises 20m of a 100m segment, simply calculate the percentage of each rating using 80 as the divisor instead of 100). The following is a description of the field datasheet classes:

- **Segment Number:** Assigned during the 2005 season. These designations denote which side of the river the segment is on, left or right (L or R). River side is assigned as one looks downstream. The following letters and numbers represent an upstream landmark (such as CB, for Clark's Bridge) followed by the distance downstream from that landmark (e.g. 200m). For example, RCB000 would be the first 100m segment downstream from Clark's Bridge on the right side of the river as one looks downstream.

Figure B. 2.8 Photo Examples of Riverbank Erosion
Type/Slope of Riverbank: Undercut, Steep (>35°), or Gentle (<35°)

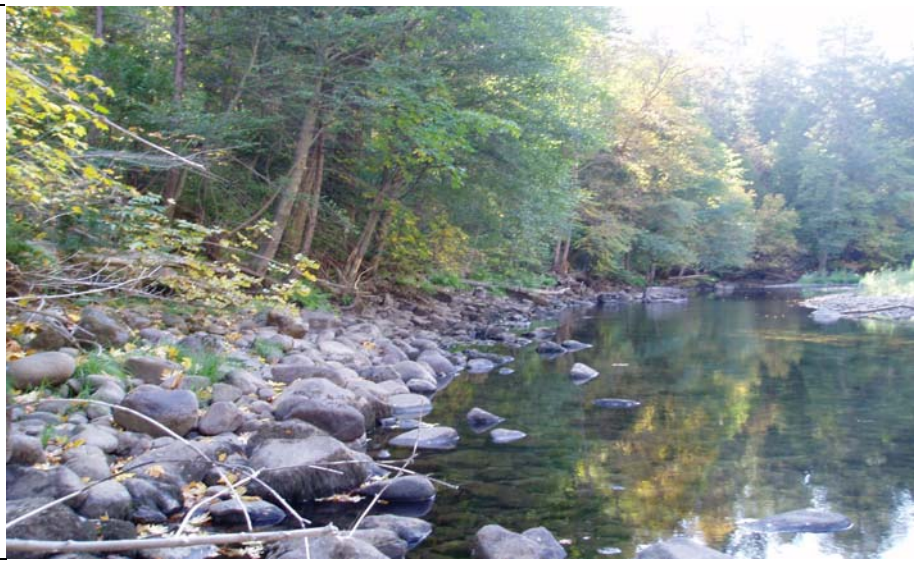
Undercut	
Steep	
Gentle	

- **Substrate Type:**
  -Fine [clays (<0.002mm), silts (0.002mm – 0.0625mm), and sands (0.0625mm – 2.0mm)]
  -Medium [granule, pebble, and gravel (2.0mm-64mm)]
  -Coarse [cobble (64mm – 256mm), boulders (>256mm), and bedrock]

  *Broad classes comprise various size-based groupings of substrates, as defined by the International Society of Soil Science
  *Substrates exhibiting mixed matrices will be recorded as that substrate type comprising over 50% of the substrate (e.g. a substrate that is 60% cobble and 40% sand will be recorded as a "coarse" substrate type)

Figure B.2.9 Photo Examples of substrate type

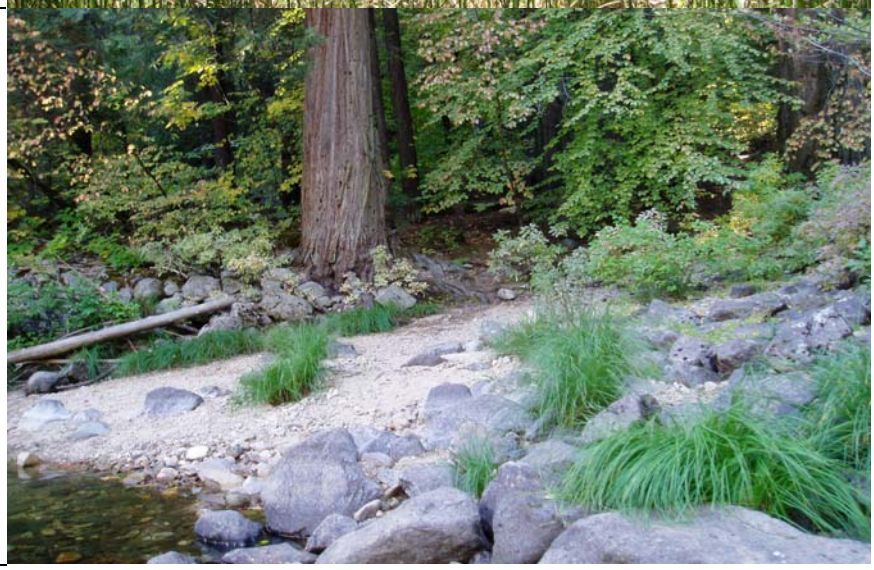
Fine	
Medium	

Coarse	

- **Vegetation Condition Rating (Adapted from Pfankuch 1975 and Platt et al. 1987):**

  1) No exposure of tree roots and/or over 75% of river bank surface is covered by a diversity of vegetation in vigorous condition or by natural gravel/boulders characterized by un-impacted interstitial substrate; Plant vigor suggests a deep, dense, soil binding, root mass
  2) Very slight exposure of tree roots; 50-75% of river bank is covered by vegetation (shrubs often prevalent) or by gravel/boulders and larger material
  3) Slight to moderate exposure of tree roots; 25-50% of the bank surface is covered by vegetation or by gravel/boulders and larger material characterized by impacted interstitial substrate. Lack of plant vigor is evident in some individuals and/or species
  4) Severe exposure of tree roots; less than 25% of the river bank surface is covered by vegetation or by gravel/boulders and larger material. Plant growth and reproductive vigor is generally poor. Root mats discontinuous and shallow.

Figure B.2.10 Photo Examples of Vegetation Condition Rating

V1	
V2	

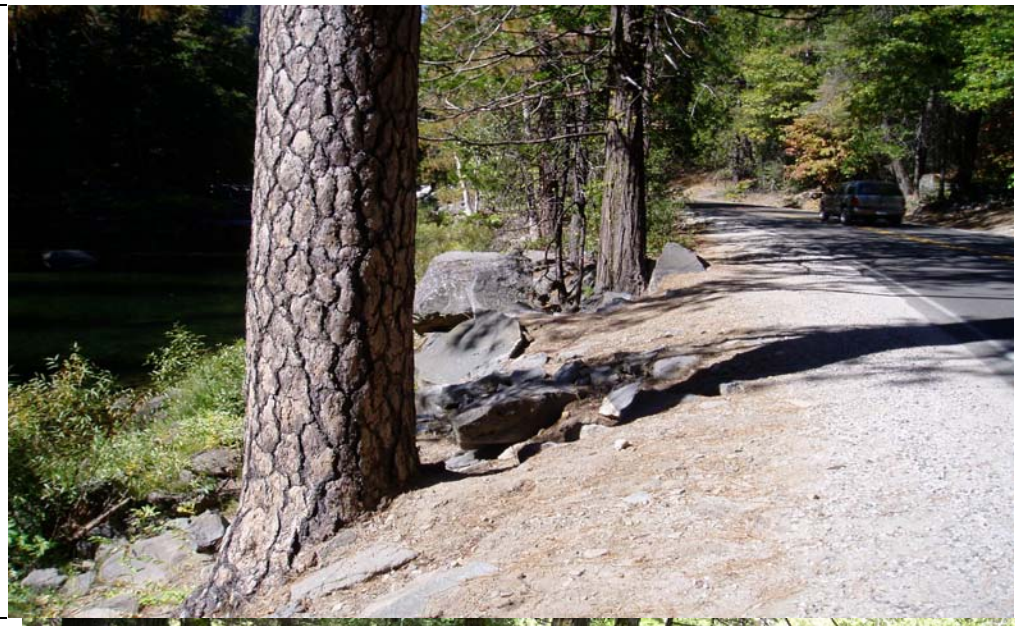
V3	
V4	

- **Erosion Condition Rating (Adapted from Morgan 1995):**

  1) No erosion features (e.g. bank scalloping, rills, gullies, scouring, sheet flow features, loss of original bank morphology or bank retreat) or erosion features exist but barely distinguishable
  2) Erosion features occupy up to 25% of segment and are dominated by visual evidence of sheet or splash erosion; Shallow rills up to 3cm deep may be present but to a very limited extent (<5% of the segment). Slight evidence of bank loss.
  3) Substantial presence (up to 50%) of erosion features (e.g. bank retreat <2m) within segment and/or rills are very common and up to 8cm deep; gullies may exist but to limited extent (5%)
  4) Widespread presence (>75%) of erosion features (e.g. bank retreat >2m) and/or gullies and rills over 8cm deep are common; evidence of mass wasting (extreme bank sloughing) may exist or will likely occur.

Figure B.2.11. Photo Examples of Erosion Condition Rating

E1	
E2	

E3	
E4	

- **Apparent cause:** Determine human vs. river caused riverbank erosion. Using best professional judgment, and assessing accessibility to site by visitors (e.g. social trailing, close proximity to trail or parking lot), record whether the erosion impacts appear to be caused by humans (H) or natural river processes (N) and record evidence of impacts (e.g. trails, trash, visitors on-site, etc.).

Figure B.2.12 Photo Examples Apparent Causes of Riverbank Erosion

Human caused	
Naturally caused	

Figure B.2.13. Riverbank Erosion rapid assessment datasheet.

Date: _____(mo)_____(dd)_____(yy)

Field Staff: _____ Weather: _____

Start Location: _____ Start UTM:_____

End Location: _____ End UTM: _____

Segment No. (include river side [looking downstream])	River Bank Type (%*)			Substrate Type (%)			Visitor Access (1-7)	Vegetation Condition Rating (%)				Erosion Condition Rating (%)			
	U	S	G	F	M	C		1	2	3	4	1	2	3	4
L001 (e.g.)	100	0	0	0	0	0	1,3	90	0	0	10	50	40	0	10
						.									

*** Estimate of the proportion (10% increments) of bank segment that falls within each category. All estimates for each indicator must add up to 100%**
Notes:

Post-collection and processing: GPS and total station survey data and digital photographs will be downloaded upon return to the office of Vegetation and Restoration, and datasheets will be copied and stored in two different locations (VERP office in Yosemite Valley and Vegetation and Restoration office in El Portal).

B.2.4. Data Management

Data entry: Collected data will be entered into a database, and digital photographs will be labeled and filed electronically. Field notes will be transferred into digital form (i.e. word processed).

Data analysis: Total station surveys will be converted into detailed profiles/maps of the permanent monitoring sites. GPS points delineating monitoring sites will also be displayed on a map. Riverbank condition indexes will be calculated using the equation below to combine vegetation condition ratings and erosion condition ratings for rapid assessment sites to facilitate communication and mapping. The range of RCI index values is from 1 to 4. Higher index values indicate more severe riverbank erosion conditions.

$$RCI = \frac{\sum(ER_i \times E_i\%) + \sum(VR_i \times V_i\%)}{2}$$

Notations:
RCI = Riverbank Condition Index
ER_i = Erosion Condition Class *i* (*i* = 1 to 4)
$E_i\%$ = % segment assigned to Erosion Condition Class *i* (values range from 0 to 1, or 100%)
VR_i = Vegetation Condition Class *i* (*i* = 1 to 4)
$V_i\%$ = % segment assigned to vegetation condition class *i* (values range from 0 to 1, or 100%)

Results from 2006 will be compared to the 2005 inventory to assess changes in riverbank erosion along the Merced.

Data reporting: Profiles/maps, riverbank condition index comparisons, and anecdotal geomorphologic information and riparian vegetation assessments will be formalized in the 2006 VERP Annual Report.

Data storage: All collected data and compiled documentation will be stored on the YOSE NPS network (ms01/EP Resources/reso/Restoration Program Commons/VERP/VERP 2006/Riverbank Erosion). GIS maps and project files can be found at (ms01/EP Resources/reso/Restoration Program Commons/GIS data/VERP/2006/Riverbank Erosion). Original datasheets will be stored in the office of Vegetation and Restoration.

B.2.5. Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): Supervisory GS-7 responsible for oversight of field work and training of personnel not familiar with indicator protocol and total station surveying. GS-7 field technician in charge of total station mapping, other tasks associated with assessment of permanent monitoring plots, implementing rapid assessment protocols, and training and supervising other field staff. Other field staff will assist in total station mapping, as well as potentially providing quality control for rapid assessments (i.e. re-monitoring rapid assessment plots, independent from the other field technician).

Projected personnel needs (for three permanent sampling locations 18 rapid assessment plots) are three field personnel for three weeks (including training), with each permanent site requiring approximately three days for assessment (two people running the total station with one person conducting vegetation assessments,

photopoints, rapid assessments, etc.) and each rapid assessment plot requiring approximately a half hour. Supervisory position should dedicate a total of three weeks (distributed between tasks of protocol refinement, training preparation, conducting assessments if needed, and trouble-shooting).

Qualifications: Supervisory GS-7 should be familiar with general river geomorphology and ecology principles, have experience in natural resource monitoring and vegetation monitoring, have experience in training personnel, and versed in GPS, GIS, and total station technologies. GS-7 field technician should have some experience with these topics, namely field implementation (GPS and total station, resource impact monitoring). Other field staff would optimally possess some of these same skills. All staff should be able to make informed condition class determinations and make appropriate recordings of riverbank attributes and conditions, such as bank type, ground vegetation cover, tree root exposure and erosion features.

Training procedures: Two days will be dedicated to familiarizing field staff with indicator and protocol, GPS unit, and total station methods. Training will be conducted by staff well-versed in protocol, preferably someone who has implemented the methodology in the past.

B.2.6. Operational Requirements

Field work plan: Field work will be conducted mid-August through September when river flows are low enough to permit safe crossing. Protocol refinement will be conducted in June and July, and data analysis and reporting will be conducted in October and November. The following is an outline of the field work schedule:

- Days 1 & 2: Training
- Days 3-10: Permanent Plot Assessments
- Days 11 & 12: Rapid Assessment Plots

*Projections of time requirements are based on 10hr workday

Safety: A job hazard analysis has been completed and appears below (Table B.2.1).

Table B.2.1 Job Hazard Analysis for VERP Riverbank Erosion indicator.

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Riverbank Erosion Monitoring	Merced River, Yosemite Valley, YNP	
Job Hazard Analysis (JHA)	3. NAME OF ANALYST	4. JOB TITLE	5. DATE PREPARED
	Christal Niederer	Technician	July, 2005
6. TASKS/PROCEDURES	7. HAZARDS	8. ABATEMENTS ACTIONS ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Walking, hiking and other physical exertion.	b. Exhaustion, muscle strain, dehydration and fatigue.	b. Drink plenty of fluids, bring snacks and/or meals if out during lunch hours, Take periodic rests and stretch before and after physical activity.	
c. Wading in river to assess riverbank conditions.	c. Tripping, falling or being swept away due to slippery, uneven river bottom surfaces and strong currents.	c. Use extreme caution in watching footing, wear life vest, only wade if the water level/current strength is low enough to permit it, collect sample from river edge if water is too high and/or swift.	
d. Working and walking along riverbanks.	d. Tripping and/or falling due to wet and slippery rocks or sloping ground surfaces, contact with poison oak, etc.	d. Watch footing, know how to identify and avoid all poison oak, rinse immediately in stream if contact occurs.	
e. Working outdoors in cold and/or wet weather.	e. Hypothermia, reduced resistance to illness.	e. Wear appropriate clothing and carry extra layers. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
f. Working outdoors in hot / extreme heat weather.	f. Fatigue, exhaustion, dehydration and heat stroke.	f. Wear appropriate clothing and use sunscreen. Drink fluids and snack throughout the day. Carry extra water and dehydration salts along with first aid kit.	
10. SUPERVISORS SIGNATURE	11. TITLE	12. DATE	

Equipment and materials: see “Preparation” in the Field Methods section

Budget:

- Term GS-7: 3 weeks at $1000/week = $3000
- Seasonal GS-7 (2): 3 weeks at $800/week per biotech = $4800
- Volunteer field staff (e.g. SCA): 3 weeks at $375/week = $1125
- Vehicle: 3 weeks at $325/week = $975
- Supplies: $300

Total = $10,200

B.2.7. References

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B. 3. Wildlife Exposure to Human Food

B.3.1 Background

The most direct and prevalent way visitors adversely affect wildlife in Yosemite is by purposely feeding animals, leaving food improperly stored, or leaving food debris on the ground or picnic tables. This leads to alteration in the animals' behavior and roles in the ecosystem, as animals exposed to human food continue to seek it out. In extreme cases, fed animals become aggressive and dangerous, and must be killed to protect human safety. This modification of wildlife behavior and ecological roles adversely affects the biological outstanding remarkable value (ORV) and that of recreation quality.

There is a likely correlation between the number of visitors in Yosemite Valley and the opportunities for wildlife to be exposed to human food. More visitors means more people feeding wildlife, more people improperly storing food, and more food debris left behind, if the proportion of visitors engaging in these behaviors remains constant over the range of visitor numbers. Also, trash cans and dumpsters are more likely to overflow, allowing animals access to garbage. The number of staff dispensing information about park regulations through personal contact, and frequency of garbage removal remains relatively constant at a given times of year, and among years, regardless of the number of visitors. Therefore, as the number of visitors goes up, the proportion of them who receive information and warnings likely goes down, the chance of overflowing trash receptacles increases, and intentional feeding of wildlife increases resulting in higher human-wildlife conflicts.

Description of indicator and standard:
Indicator: Number of instances wildlife could be exposed to human food.
Standard: 95% or greater compliance with food storage regulations in selected campgrounds and parking areas.
Zone(s): Zone 2C Day Use, Zone 2D Attraction, Zone 3A Camping, Zone 3B Visitor Base and Lodging

Rationale for indicator: Current management of human-wildlife conflicts call for "zero tolerance" for allowing animals access to human food. This is especially true for black bears, which quickly become conditioned to human food and, as a result, can become dangerously aggressive and must be killed. The severity of this problem requires the expenditure of considerable funding and staff time to provide visitor education, patrol to look for food left available to animals, enforce food storage regulations, and haze bears out of developed areas. Despite these extensive efforts, and the zero tolerance policy, it is unrealistic to believe that *all* availability of human food to wildlife can be controlled. It was, therefore, decided that steady progress in removing human food from the diets of wildlife would be a reasonable measure of the effect of visitation level on wildlife exposure to human food.

Objectives: Provide accurate assessment of food storage compliance rates and food storage violations in campgrounds and parking lots.

B.3.2 Sampling Design

Currently, statistics on the availability of human food to wildlife is documented through the park's Bear Patrol Log Database (BPLD). The BPLD was developed for the Human-Bear Management Program in 2005 to ensure accountability with bear-funded employees and to collect data on bear monitoring and management activities in the field. In Yosemite Valley, there are an average of 15 bear funded employees that spend a minimum 80% of their time on bear related issues between the months of May and October. These employees include Protection, Campground and Interpretation Rangers, and Wildlife Technicians. While the primary duties differ among work units, all employees share the common goal of mitigating human-bear

conflicts and protecting wildlife from exposure to human food. This is accomplished through proactive patrols between the hours of 5 p.m. and 6 a.m. when bear activity is the greatest. During patrols, visitors are

educated about proper food storage through one-on-one interpretive contacts, campsites and vehicles are checked for food storage compliance, and food storage regulations are enforced through verbal or written warnings and citations.

For this indicator, average compliance rates are determined by inspecting either a certain number of campsites or vehicles. Non-compliance is defined as an incident in which *a violation of human food-related park regulations is observed by the field staff that necessitates immediate management action such as issuing verbal or written warning*.

Non-compliance includes the following violations:

B.1. Feeding human food to wildlife – Knowingly offering human food or baiting wildlife.

B.2. Improper food storage – Human food stored in locations that are considered inappropriate, such as inside vehicles after dark or in containers that are not approved by the park as wildlife resistant;

B.3. Improper use of food locker – Food is put in food locker but the locker is wide open, unlocked, or not latched in a way consistent with the instructions provided and the visitors are either away from their site or asleep.

B.4. Leaving food unattended – Food left in open locker, out in campsite, or other location where the food is out of arms reach, is not actively being prepared or eaten, and/or the food is not visible to any of the camp occupants.

Campground inspections to determine compliance rates are generally conducted after 10 p.m. when most visitors are finished eating dinner and food is put away. Inspections conducted earlier than 10 p.m. often result in a very low compliance rate because most people preparing dinner have their food lockers open and food items out of arms reach. These incidents are documented in the BPLD as educational contacts rather than violation or inspection records.

Parking lot inspections are conducted throughout the night, but because food stored inside vehicles during daylight hours is legal, compliance checks on vehicles can only be performed after dark.

On many occasions, especially when responding directly to bear activity, food storage violations are found, corrected and documented, but are not calculated in the average compliance rate for an area because they are not part of an inspection. In the BPLD, food storage violation records can either stand alone or be part of an inspection record.

Site Selection: Inspections will take place in the following Yosemite Valley locations: Upper Pines Campground (C.G.), North Pines C.G., Lower Pines C.G., Camp 4 C.G., Housekeeping Camp (campsites only), Curry Village Parking Lots, Curry Orchard Parking Lot, Ahwahnee Parking Lot, Yosemite Lodge Parking Lot, Wilderness Lot, and Camp 4 Parking Lot.

Sampling Schedule: Inspections will be performed as time permits, but no less than once a week for each location, from Memorial Day Weekend through Labor Day Weekend. Inspections will occur during weekdays and weekends.

B.3.3 Field Methods

Preparation: Gather all datasheets or the handheld computer (PDA).

Data collection and measurement: Procedures listed below are taken from the Bear Patrol Log Database Manual on collecting and entering data.

INSPECTIONS

- All inspections will be entered into the Bear Patrol Log Database. Data will include the date, location, start and end time, number of campsites or vehicles checked, and the number of campsites or vehicles that are non-compliant.
- Inspections of campsites and Housekeeping Camp units should occur only after the dinner hour when visitors are not preparing food.
- Inspections of vehicles must be completed after dark.
- Inspections of concessions facilities except Housekeeping Camp units may be completed at any time of day or night.
- If non-compliant vehicles, campsites, facilities or trashcans are found, a food storage detail record must be completed for those violations. For example if 300 cars are checked and 4 are found with food in them and the visitors are woken up because of food in their cars, an inspection detail would be completed along with a food storage detail. The food storage detail would list the 4 violations of unattended food in vehicle and the action would be a verbal warning.

FOOD STORAGE VIOLATIONS

- Spot checks for food storage violations occur on a nightly basis during patrols. All violations will be entered into the Bear Patrol Log Database. Data will include the date, location, time violation was found, type of violation, number of violations if more than one, and the type of warning issued.

- Violation Types:

    - **Baiting -** Knowingly offering or leaving human food for wildlife.
    - **Bear Box/Improperly Locked -** Food is put in food locker but the locker is not latched in a way consistent with the instructions. The visitors may be either away from their site, inside a tent or vehicle (RV) or asleep.
    - **Bear Box/Left Open -** Food is put in food locker, but the locker is wide open or completely unlatched **and** the visitors are either away from their site, inside a tent or vehicle (RV) or asleep.
    - **Bear Locker Deficiency -** Anything that makes a locker not bear proof, difficult to operate, or otherwise requiring repair. Example: latch does not operate properly.
    - **Unattended/Food or Attractant -** Food left out in campsite, or other location and the visitor is not in the campsite or asleep. Example: Camper at Upper Pines is no where to be found (i.e. in bathroom or sleeping) and there is a bag of marshmallows on his picnic table.
    - **Visitors Too Far From Food -** Visitor is in site and awake. Food left in open locker, out in campsite, or other location where the food is out of arms reach, is not actively being prepared or eaten. Example: Campers in Upper Pines are sitting around fire with their back turned to their food and are 10 feet away.
    - **Unattended/Food or Attractant in Vehicle.**
    - **OB Camper w/Food in Vehicle**
    - **Unsecured Recycling Container.** Container is not closed properly.
    - **Unsecured Trash Can**. Container is not closed properly.
    - **Recycling Container Deficiency.** Anything that makes it not bear proof, difficult to operate, or otherwise requiring repair.
    - **Trash Can Deficiency.** Anything that makes it not bear proof, difficult to operate, or otherwise requiring repair.

- **Trash Can/Overflowing**

Figure B.3.1 Datasheet- Wildlife Exposure to Human Food

2006 BEAR MANAGEMENT PATROL LOG

DATE: **Name(s):**

INSPECTIONS (CARS, CAMPSITES, CONCESSION FACILITIES)

Location	Start Time	End Time	Number Checked	# Non-Compliant

VISITOR CONTACTS

Location	Number of Contacts
Upper Pines	
Lower Pines	
North Pines	
Camp 4	
Housekeeping	

FOOD STORAGE VIOLATIONS

Location	Site	Time	Violation	Warning Type	Number of Violations

B.3.4 Data Management

Data entry: Patrol data will be recorded on PDA's or datasheets. Data will then be entered into the Bear Patrol Log Database at the end of each patrol shift, or at the beginning of the next patrol shift.

Data analysis: Data for this indicator will be queried and analyzed each November for the summary report. Quality control will be performed by the Wildlife Management Office at least once a week in May and June and once a month for the remainder of the season. Food storage compliance rates will be determined by taking the average compliance rate each month from May through September. Compliance rates will be analyzed for each monitoring site.

Data reporting: Results will be compiled and presented in the VERP Annual Report. Additionally, information will be presented at a public meeting and made available on the park's website.

Data storage: The Bear Patrol Log Database is stored on the park's network and can be accessed through Citrix. Hard copies of completed datasheets will remain on file with the Wildlife Office and copies sent to the Integrated Resources Analysis Branch in El Portal.

B.3.5 Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): Monitoring efforts and data collection will be performed by the Yosemite Interdivisional Bear Team. This team is comprised of employees from several different work units including Campground, Interpretation and Protection Rangers, and Wildlife Technicians. An average of 20+ individuals will be involved in the data collection. The Wildlife Management Branch is responsible for the Bear Patrol Log Database including maintenance, quality control, improvements, and training.

Qualifications: Before data is collected, all employees, volunteers, and interns on the Interdivisional Bear Team will be trained in bear management and patrol activities, black bear biology, the Bear Patrol Log Database, and data collection methods.

Training: Wildlife Management staff with experience surveying and monitoring non-compliance of food storage will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Ability to navigate to inspection sites.
- Identify and differentiate various types of non-compliance.
- Make appropriate recordings for non-compliance and related attributes.
- Enter field data into the Bear Patrol Log Database.

These skills will be verified through field training and assistance of qualified Wildlife Management staff. In addition, all members of the bear team using the database will be given a copy of the Bear Patrol Log Database Manual.

B.3.6 Operational Requirements

Safety: Particular attention will need to be given to collecting data in a safe manner as personnel will be working at night, alone in some occasions and within high use bear activity areas. A job hazard analysis has been completed and appears below (Table B.3.1).

Table B.3.1 Job Hazard Analysis for Wildlife Exposure to Human Food

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Wildlife Monitoring	**Yosemite Valley, YNP**	
Job Hazard Analysis (JHA)	3. NAME OF ANALYST	4. JOB TITLE	5. DATE PREPARED
	Tori Seher	**Wildlife Biologist**	**July, 2006**
6. TASKS/PROCEDURES	7. HAZARDS	8. ABATEMENTS ACTIONS **ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE**	
a. Driving to, from, and around sampling sites.	**a. Collision resulting in damage, injury, or death.**	**a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.**	
b. Walking, hiking and other physical exertion.	**b. Exhaustion, muscle strain, dehydration and fatigue.**	**b. Drink plenty of fluids, bring snacks and/or meals if out during lunch hours, Take periodic rests and stretch before and after physical activity.**	
c. Encountering / managing wildlife.	**c. Bite, attack or other injury resulting from incidental or violent interaction with wildlife or the use of wildlife management tools such as firearms.**	**c. Work in coordination with trained wildlife staff, use caution when dealing with wildlife and follow appropriate safety procedures for the use of management tools such as firearms. Carry first-aid kit and radio during patrols.**	
d. Working outdoors in cold and/or wet weather.	**d. Hypothermia, reduced resistance to illness.**	**d. Wear appropriate clothing and carry extra layers. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.**	
e. Working during nighttime hours.	**e. Injury resulting from over-tired or exhausted condition due to late night working hours and working in the dark.**	**e. Maintain healthy sleeping habits. Eat and drink appropriate meals for consistent energy (coffee is not an appropriate food source). If overly tired, take breaks and rest. Always carry charged flashlights with extra batteries.**	
10. SUPERVISORS SIGNATURE	11. TITLE	12. DATE	

Equipment and supplies:

1 Flashlights and headlamps with extra batteries
3 Park radio
4 Field forms: Data sheets
5 Clipboard/pencils
6 Warning flyers/notices
7 Manual counter
8 PDA handheld device (optional)
9 Digital camera

Budget: This budget lists the costs for personal services, vehicles, and supplies required to collect, analyze, and report data for this VERP indicator through fiscal year 2006 (September 30).

2006 INTERDIVISIONAL BEAR TEAM BUDGET	
Personal Services:	
GS-5 Valley Campground Rangers (2)	$32,476.00
GS-5 Valley Interpretation Rangers (3)	$56,373.00
Valley Interpretation Interns (2)	$7,000.00
Wildlife Management Permanent Staff	$151,159.00
GS-5 Valley Wildlife Technicians (2)	$34,338.00
Valley Wildlife Interns and VIP's	$7,425.00
GS-7 Valley Protection Rangers (2)	$44,138.00
Vehicle Costs	$7,210.00
Supplies	$6,326.00
TOTAL	**$346,445.00**

B.3.7 References:

1982 Graber, D.M. Ecology and management of black bears in Yosemite National Park. Coop. Parks Studies Unit, Univ. of Calif. Davis, Tech. Report No. 5. 206 pp.

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1995 Thompson, S.C., and K.E. McCurdy. Black bear management in Yosemite National Park: more a people management problem. Proceedings of the Fifth Western Black Bear Workshop. pp 105 – 115.

B.4. Extent and Condition of Non-Formal Trails

B.4.1 Background

Non-formal trails (or visitor-created "social" trails) may be defined as discernible and continuous trail segments that were created by visitors and which do not follow a park's formal trail system (Leung et al. 2002). Since non-formal trails are not planned or constructed they are usually poorly located with respect to terrain. These trails also receive no or very little maintenance. These factors substantially increase their potential for degradation in comparison to formal trails. The proliferation of non-formal trails may increase habitat fragmentation and can directly threaten sensitive habitats when crossed or accessed by unplanned trails (Tylser and Joghson 2004). From a social perspective a web of non-formal trails create a visually scarred landscape and may lead to safety and liability concerns. Due to their ecological and social significance, non-formal trails are a common indicator selected in different implementations of NPS's VERP planning framework and Vital Signs monitoring program.

Monitoring can provide timely information on the extent, distribution and condition of non-formal trail segments. Such information can serve as warning signs of resource degradation and habitat intrusion and can trigger management actions if standards established to specify minimum acceptable conditions are exceeded. Most previous monitoring studies on non-formal trails have focused on their proliferation in the park landscape rather than resource conditions on tread conditions. Three main monitoring approaches have been developed specifically for non-formal trails. Some past visitor impact studies had non-formal trails included as an indicator with the level of proliferation assessed by tallying the occurrence of non-formal trail segments extending from formal trail networks or recreation sites (Marion 1994; Leung et al. 2002). Alternatively the entire non-formal trail network of a park or selected portions of a park can be inventoried and mapped (Cole et al. 1997; Leung et al. 2002). Most of these studies have also incorporated condition class ratings to the assessments. Finally, very few studies have actually monitored non-formal trail networks more than one time to enable a temporal evaluation (YOSE 2005). Due to the extensive nature of some non-formal trail networks the efficiency of field assessments is a particular concern. The advent of geospatial techniques seems to provide potential solutions to this challenge, though such technologies benefit monitoring of formal trails as well.

Major developments are currently occurring with the rapid advancements of geospatial technologies, such as geographic information systems (GIS), global positioning system (GPS), remotely sensing and the digital spatial data. These technologies are particularly relevant to non-formal trail monitoring due to their dispersed spatial distribution. Witztum and Stow (2004) demonstrated the utility of multi-spectral imagery and digital image processing techniques in extracting non-formal trails in a coastal sage scrub community.

This field protocol presents the data requirements and data collection procedures for surveying the extent and condition of non-formal trails in selected sites in Yosemite Valley and Tuolumne Meadows, an indicator that was first implemented in 2004 and addressed total length of non-formal trails in meadows. The User Capacity Management Program identified two zones to be monitored in Yosemite Valley, 2B Discovery and 2C Day Use. The meadows to be monitored in those zones are: Stoneman, Ahwahnee, Cooks, Sentinel, Woskey Pond, Leidig, El Capitan, and Bridalveil. To add to baseline data being collected for the Tuolumne Meadows Concept plan, monitoring was expanded to the Tuolumne Meadows area in 2005, and non-formal trails were mapped in the main meadow areas on the north side of Tioga Road. In 2006, monitoring will include meadows on the South side of Tioga Road, and other areas encompassed by the Tuolumne Wild and Scenic corridor and the Tuolumne Concept Plan. The standards presented in the User Capacity Management Program were based on 1990 data. It was decided that data on current conditions should be used as the basis for future monitoring. This methodology described will be used to

determine current conditions and to monitor them in the future. The standards were revised to develop a more rigorous data set from which future monitoring efforts will be measured.

Original methodology was refined and repeated in 2005 to confirm 2004 mapping results. Particular attention was placed on clarifying condition class definitions. Resulting from workgroups in 2005 and 2006, it has been decided that the *extent* of non-formal trails (as represented by density of non-formal trails) is a more meaningful parameter than solely *length* of non-formal trails because it is relative and allows for cross-meadow comparisons. In 2006, condition classes will again be assigned to all mapped trails, and disturbed areas will be mapped, so that an integrated parameter of "density of disturbed area" can also be achieved. Otherwise, most methodologies will remain consistent with 2005 protocol.

Description of indicator and standard
Indicator: Extent (density) and condition of non-formal trails in the meadows of Yosemite Valley and in the meadows and high use areas of Tuolumne Meadows. These are specific areas of concern due to their location within the corridors of the Merced and Tuolumne Rivers, which have been given the congressional status of "Wild and Scenic", thereby requiring compliance with the regulations protecting rivers of this designation.
Standard: No net increase in density of non-formal trails when compared with baseline (for Yosemite Valley). Baseline established in 2004 and 2005. In Tuolumne Meadows, 2006 mapping will add to data collected in 2005 to increase baseline dataset. Baseline will be updated as restoration actions are implemented and data is re-collected to reflect restoration efforts. In addition, a range of density threshold values of disturbed areas and trailing will be developed through consultation with professionals specializing in recreation and meadow ecology. The resulting standard will be developed through a combined effort from scientists and park management/planning specialists and will be based on desired conditions associated with particular management zones designed to protect Wild and Scenic River ORV's.
Zone(s): 2B Discovery, 2C Day Use, and Tuolumne Meadows Concept Plan area.

Rationale for indicator: The extent and condition of non-formal trails is indicative of the contiguity and ecological health of meadows and wetland areas - reflecting part of the biological Outstandingly Remarkable Values of the Merced and Tuolumne River corridors. It is also indicative of impacts to wildlife habitat, including special-status species (biological Outstandingly Remarkable Value). Archeological sites and traditional gathering areas used by American Indian groups exist in some meadows, and could be affected by the proliferation and length of non-formal trails in meadows (cultural Outstandingly Remarkable Values). The proliferation of non-formal trails in meadows may affect visitor experience, as meadows are enjoyable areas in which to engage in a variety of river-related recreational opportunities—including nature study, photography, etc. (recreation Outstandingly Remarkable Value), and non-formal trails may impact the scenic interface of river, rock, meadow, and forest. In this manner, monitoring the length of non-formal trails in meadows also contributes to the protection and enhancement of the scenic Outstandingly Remarkable Value of the river corridor.

Objectives
To document the extent and condition of non-formal trails in meadows of Yosemite Valley and Tuolumne Meadows to further establish baseline data on these impacts and to compare results (where applicable) to data collected in 2004 and 2005. Results will be used to inform management decisions regarding protection of meadow health.

B.4.2 Sampling Design

Rationale for sampling design: In 2004, a GPS inventory of non-formal trails in the meadows of Yosemite Valley was undertaken. Monitoring was repeated in 2005 to verify results and explore potential factors that could cause variation in collected data (e.g. monitoring post-deer rut, which potentially skewed results; weather variability influencing soil moisture and trailing patterns, etc.). In 2006,

investigations in the Valley will be limited to the meadows that exhibited an increase in non-formal trail length between 2004 and 2005 to confirm trends in non-formal trail development. Another meadow will randomly be chosen for monitoring to initiate the long-term monitoring project that will focus on detecting proliferation of non-formal trails. In the future, the random monitoring of meadows, in addition to monitoring those areas exhibiting trends toward non-formal trail increases, will hopefully suffice to capturing the range of long- and short-term impacts caused by the many activities in these two very busy areas of the park. Full scale inventories of meadows in Yosemite Valley should be completed (through rotation or other procedures) every five years, as annual environmental variability is too high to accurately detect changes in meadow impacts and health over shorter time intervals.

In Tuolumne Meadows, no data existed on non-formal trails until mapping was conducted in the main meadow area (north of Highway 120, east of Pothole Dome, and west of Lembert Dome) in 2005. 2006 monitoring efforts will be focused on expanding this baseline data in high use areas to the east of the Highway 120 Bridge. This inventory of non-formal trails in the Tuolumne meadows areas is needed to create a baseline to which data from subsequent monitoring efforts can be compared. It will also be used in the Tuolumne Meadows Concept Plan planning efforts. Later assessments may involve monitoring selected meadow areas via a sampling scheme similar to the one described above for Yosemite Valley.

Site selection: In Yosemite Valley, meadows showing an increase in non-formal trail length between 2004 and 2005 that will be monitored in 2006 are El Capitan, Cooks, and Stoneman. In addition, Wosky Pond, was selected (using a random number table) to be the first meadow in the Valley on the annual circuit of monitoring. Meadows in the Tuolumne Meadows area encompassed by the Tuolumne Development Concept Plan and Wild and Scenic river corridor may be included in the 2006 monitoring. This may also include heavily used areas near the campground, lodge, and upstream on the Lyell Fork of the Tuolumne River.

Sampling schedule: In Yosemite Valley, monitoring will be conducted over a four-week period, between mid-July and mid-August (before the fall deer rut). In Tuolumne Meadows, monitoring will be conducted in August.

B.4.3 Field Methods

Preparation: Field personnel should be trained (see Training, below) and the following required tools and supplies should be acquired:

- GPS
- Clipboard and pencils
- Notebook
- Measuring tape
- Copy of indicator protocol
- Map of area of interest
- Digital camera
- Photo-documentation sheets (on waterproof paper)
- Pin flags
- Radio
- Water
- Lunch

Data collection and measurement: Field technicians should travel to the meadow to be monitored, and turn on GPS, so that it can begin to acquire satellites. Follow “Field Instructions” for complete, step-by-step data dictionary procedures.

Non-formal trail classifications should be entered into the GPS as line features, barely discernable trail transitions as point features, disturbed areas less than 200sq. ft as point features (with the area

approximated to the nearest 100sq. ft), and disturbed areas greater than 200sq. ft should be delineated with a line feature,

later to be transformed to polygons. Identify which of the five different trail classifications should be applied to each section of non-formal trail encountered:

Barely Discernable Trail (point feature)
- Slight evidence of trail feature consisting of disturbed vegetation that has been pushed aside or is lying down, but is too faint to follow with a line feature.
- This may also be where a once discernable trail has now transitioned into a trail that is too faint to follow.

Flattened Vegetation (line feature)
- Distinct trail feature present.
- Light repeated human use evident.
- Vegetation has been trampled and matted down.

Stunted Vegetation (line feature
- Distinct trail feature present
- Moderate repeated human use evident.
- Vegetation has been trampled and matted down AND vegetation growth noticeably impeded.

Some Bare Ground
- Distinct trail feature present.
- Heavy repeated human use evident.
- Vegetation has been trampled and matted down AND vegetation growth noticeably impeded AND some bare ground present in trail tread.
- Vegetation loss in trail tread evident resulting in some bare ground exposure.

Barren Ground
- Distinct trail feature present.
- Extensive repeated human use evident.
- Vegetation has been trampled and matted down AND vegetation growth noticeably impeded AND bare ground present in trail tread throughout.
- Vegetation loss in trail tread extensive, resulting in bare ground exposure throughout.

Disturbed Area
- High use area exhibiting stunted vegetation to barren characteristics

Figure B.4.1 Photo Examples of Non-Formal Trail Features and Conditions

Barely Discernable Trail



Non-formal Trail: Flattened Vegetation




Non-formal Trail: Stunted Vegetation

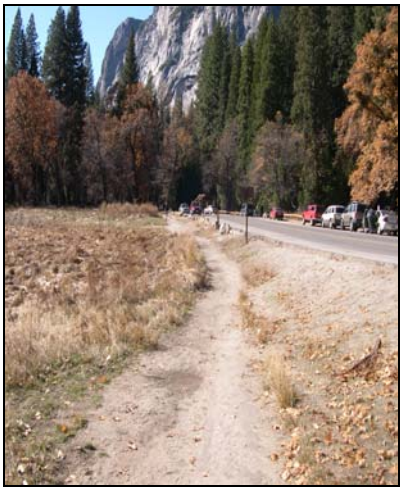


Non-formal Trail: Some Bare Ground



Non-formal Trail: Barren





Disturbed area



General tips for mapping:

For trails identified as barely discernable, enter the location in the GPS unit as a point feature. The point location should be taken at the place where the barely discernable trail started or intersected with another trail. Make a determination on whether the trail was apparently caused by humans or apparently caused by wildlife.

All trail classifications should be entered into the GPS unit with a line feature from beginning to end, or to where that trail became barely discernable, at which time, a point feature should be recorded.

All trails should be mapped, even if they are relatively short.

Trail widths for all trails should be recorded, not just “barren” trails.

Indicate whether braiding is occurring: indicate number of braids and total width of braiding. Map parallel trails separately unless they are densely braided (i.e. within 2ft of each other), in which case use the “braided’ field.

Indicate whether rutting is occurring and record the rutting depth in inches.

When encountering a disturbed area (high use area exhibiting stunted vegetation to barren characteristics), indicating a high level of use and it is determined that the area is not necessarily a trail, record a point feature in the middle of the disturbed area if it is less than 200ft². Estimate the approximate square footage of the disturbed area and record. If the disturbed area is greater than 200ft², use the “disturbed area” line feature and delineate it as a polygon.

If a trail changes from one classification to another, the first line feature with the first classification should be stopped, and another line feature with the new classification started. If the new trail segment’s classification extends for less than 25 feet, the change in classification should be disregarded, and the original line feature continued. Similarly, if a barren trail’s width changes dramatically (greater than 6 inches), a new line feature should be started with the new barren width recorded. Again, if a trail with a new barren width continues for less than 25 feet, the original line feature should be continued.

GPS mapping of trails in El Capitan meadow will be replicated by two different people, to ensure quality control of monitoring practices (i.e. a trail that one person is calling “barren” is also being called “barren” by another technician).

DATA DICTIONARY FIELDS:

For all features:

- **Meadow Name:** Record the name of the meadow being monitored (in Yosemite Valley)
  1) El Capitan
  2) Wosky Pond
  3) Cooks
  4) Stoneman

- **ID number:** unique value for each trail (automatically generated)

- **Date:** automatically generated

- **Time:** automatically generated

- **Comments:** enter any comments you have about the feature, or if unique conditions exist (e.g. trash, large group of people in area, etc.)

***The following fields are unique to each specified feature**

Non-formal Trail (Line Segment):

- **Classification**: Record condition class of trail:
  - Flattened Vegetation
  - Stunted Vegetation
  - Some Bare Ground
  - Barren

- **Width**: Record the width of the trail to the nearest 6in.

- **Source:** Record whether the trail appears to caused by wildlife, humans, or origin unknown

- **Braiding:** Indicate whether braiding is occurring

- **Braiding width:** Indicate the total width of the braiding complex in feet

- **Rutting:** Indicate whether rutting is occurring

- **Rutting depth:** If rutting is occurring, indicate the rutting depth in inches

Barely Discernable Trail (Point Feature):

- **Source:** Record whether the trail appears to be caused by wildlife, humans, or origin unknown

Disturbed Area <200ft² (Point Feature):

- **Approximate size in square feet**: Record the approximate size of disturbed area

Meadow Boundary (Line feature): Delineate meadow perimeter. This task was executed in 2004 and repeated in 2005, finding little variability between the two years. For this reason, the meadow boundaries will not be re-mapped in 2006, but this task should be completed every five years

Disturbed Area Boundary (Line Feature): Delineate a polygon when the disturbed area is >200ft². These will later be converted to polygons in GIS.

Post-collection and processing: Each day following field work, technicians will return to the Vegetation and Restoration office to download the GPS (see "Downloading GPS" instructions), download photos, update photo-documentation and time spent records, and charge camera batteries.

End of season procedures: Following completion field work, data will be managed properly (see Data Management section), and a report will be compiled.

B.4.4 Data Management

Data entry: GPS data will be downloaded at the end of each day, and these files will be converted to GIS shape-files for mapping purposes. All photos shall be given file names with the date collected and the condition class (e.g. 071306_barren). These photos shall be imported into a word document for photo-

documentation and annotated with the day's notes. Time spent will be entered into the "time spent" word file, with a description of the work completed that day.

Data analysis: GIS data will be converted into maps depicting non-formal trails in the areas being monitored and calculations in ArcGIS 9 on non-formal trail features and meadow polygons will be completed to achieve non-formal trail density results.

Data reporting: Maps, non-formal trail density, and other data will be formalized in the 2006 VERP Report.

Data storage (meta-data): All GPS data (Trimble files) will be stored in ms01/EP Resources/Restoration Program Commons/GPS Data/VERP/2006/Non-formal Trails/Valley or Tuolumne. All GIS shapefiles will be stored in ms01/EP Resources/Restoration Program Commons/GIS Data/VERP/2006/Non-formal Trails/Valley or Tuolumne. All photos will be stored in ms01/EP Resources/Restoration Program Commons/VERP/2006/Non-formal Trails/Valley or Tuolumne/Photos

B.4.5 Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): A Supervisory GS-7 will be responsible for oversight of field work in Yosemite Valley, GPS mapping of non-formal trails in Tuolumne Meadows, downloading GPS data from Tuolumne Meadows, creating ArcGIS maps of results, management of GIS files and mapping, training of field personnel (GPS procedures, condition class assessment procedures, etc.), and report writing. GS-6 support personnel will serve as the point of contact for the field technician in Yosemite Valley on a day-to-day basis. The field technician will be responsible for the mapping of non-formal trails in the designated sites within Yosemite Valley, downloading the GPS, and maintaining accurate and complete records of field work.

Projected time commitments are as follows:

- Supervisory GS-7: one week for training supporting and field personnel and refining protocol, 3-4 weeks for GPS mapping of trails in Tuolumne Meadows, and three weeks for mapping and reporting
- Supporting GS-6: total of 4-6 hours per week of oversight for field tech
- Field technician (i.e. SCA intern): three to four weeks for monitoring non-formal trails in selected areas of Yosemite Valley

Qualifications: Supervisory GS-7 should be knowledgeable with the VERP program, VERP Non-formal Trails protocols, and condition class assessments. They should also be comfortable in a supervisory role and should have background in the natural sciences or resources/recreation management. The supporting GS-6 should also hopefully have experience in the fields mentioned above, be able to communicate well, and be comfortable in a leadership position. The field technician should also hopefully have experience in the fields mentioned above, as well as have the ability to pay attention to detail, follow instructions, work independently, and successfully operate a GPS and computer software for downloading and documentation.

Training procedures: Vegetation and Restoration Management staff with experience conducting non-formal trail surveys will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Ability to navigate to target sites at meadows.
- Operate a GPS device.
- Download GPS data (see attached instructions), as well documentation of time spent and photos taken using the proper forms

These skills will be verified through field training and assistance of qualified Vegetation and Restoration Management staff.

B.4.6 Operational Requirements

Work plan: Protocol refinements conducted prior to field season in April, May, and June over a one-week total time period. Field work conducted Mid-July through mid-August in Yosemite Valley and in August in Tuolumne Meadows on the following schedule:

Yosemite Valley:

- Week 1 (field tech and GS-7 term): training and quality assurance
- Week 2-4 (field tech): mapping and assessments of non-formal trails and disturbed areas in El Cap, Cooks, Stoneman, and Wosky Pond meadows
- End of week 4 (field tech): mapping disturbed areas found in 2005 (where only point features were taken)
- Mapping and reporting conducted over a two-week time period following field work.

Tuolumne Meadows:

- Week 1-2 (GS-7 term): mapping and assessments of non-formal trails in areas near Tuolumne Campground, south of Highway 120 bridge (areas north of bridge were mapped in 2005)
- Week 2-3 (GS-7 term): mapping and assessments of non-formal trails in areas upstream from 120 bridge on Dana Fork
- Week 3-4 (GS-7 term): mapping and assessments of non-formal trails in other areas encompassed by the Tuolumne Development Concept Plan and other high use areas (e.g. Cathedral Lakes trailhead, Tuolumne Lodge area)
- Mapping and reporting will be conducted over a one-week time period following field work.

Safety: A job hazard analysis has been completed for this indicator. See table below (Table B.4.1).

Table B.4.1 Job Hazard Analysis for VERP Extent and Condition of Non-formal Trails

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Non-formal Trail Monitoring	Yosemite Valley and Tuolumne Meadows, YNP	
Job Hazard Analysis (JHA)	**3. NAME OF ANALYST**	**4. JOB TITLE**	**5. DATE PREPARED**
	Crystal Elliot	Technician	June, 2006
6. TASKS/PROCEDURES	**7. HAZARDS**	**8. ABATEMENTS ACTIONS** ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Hiking through and working in meadows.	b. Inclement weather, heat, dehydration; poison oak; insects and snakes.	b. Dress appropriately, drink plenty of fluids, bring snacks and/or meals if out during lunch hours, carry first-aid kit including snake-bite kit and Tecnu, in case of contact with poison oak. An Epy pen may be necessary to carry as well.	
c. Working and walking along riverbanks.	c. Tripping and/or falling due to wet and slippery rocks or sloping ground surfaces, contact with poison oak, etc.	c. Watch footing, know how to identify and avoid all poison oak, rinse immediately in stream if contact occurs.	
d. Working outdoors in hot, dry conditions.	d. Dehydration, heat exhaustion.	d. Stay hydrated. Take frequent breaks if weather is uncomfortably warm. Use sun protection (e.g. hat).	
e. Working outdoors in cold and/or wet weather.	e. Hypothermia, reduced resistance to illness.	e. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
10. SUPERVISORS SIGNATURE	**11. TITLE**	**12. DATE**	

Equipment and materials: see ”Preparation” in the Field Methods section

Budget:
- Term GS-7: 8 weeks at $1000/wk=$8000
- Seasonal GS-6: 2 weeks (distribution of 4-6hr/wk over course of season) at $750/wk=$1500
- Volunteer field staff (e.g. SCA): 4 weeks at $375/week = $1500
- Vehicles: 2 vehicles for 1.0 months at $650/mo = $1300
- Equipment and materials: $200 (assuming that GPS units do not need to be purchased)

Total = $12,500

B.4.7. References

Cole, D.N., A.E. Watson, T.E. Hall, and D.R. Spildie. 1997. *High-Use Destinations in Wilderness: Social and Biophysical Impacts, Visitor Responses, and Management Options*. Research Paper INT-RP-496. Ogden, UT: USDA Forest Service, Intermountain Research Station.

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Marion, J. L. 1994. *An Assessment of Trail Conditions in Great Smoky Mountains National Park (Research/Resources Management Report).* Atlanta, GA: USDI National Park Service, Southeast Region.

Tyser, R.W., and C.A. Christopher. 1992. Alien flora in grasslands adjacent to road and trail corridors in Glacier National Park, Montana (U.S.A.). *Conservation Biology* 6(2), 253-262.

Witztum, E.R., and D.A. Stow. 2004. Analyzing direct impacts of recreation activity on coastal sage scrub habitat with very high resolution multi-spectral imagery. *International Journal of Remote Sensing* 25(17), 3477-3496.

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B.5. WILDERNESS ENCOUNTERS

B.5.1. Background

The Wilderness Act of 1964 mandates that designated wilderness will have “outstanding opportunities for solitude”. While there is some disagreement about the value of monitoring encounters as a measure of wilderness experience quality (Stewart 2001; Cole, 1996), historically, wilderness managers have considered inter-group encounters as a primary threat to solitude (Watson 1998). In the most comprehensive study of visitor experience in the Yosemite Wilderness, Newman (Newman 2002) found encounters with other parties to be the second most important attribute affecting the quality of experience in a trade-off analysis.

This field protocol presents the procedures, data requirements and data collection sheets for the number of encounters Yosemite NP rangers or volunteers have with visitors on trails. The User Capacity Management Program identified two zones that should be monitored. A more detailed description of this indicator is presented on page 49 of the User Capacity Management Program.

DESCRIPTION OF INDICATOR AND STANDARD:

Zones: 1A: Un-trailed; 1B: Trailed Travel

Standards:

- Zone 1A: Un-trailed—No more than one encounter per four hour period, 80 percent of the time.
- Zone 1B: Trailed Travel— No more than one encounter per hour, 80 percent of the time.

Rationale for indicator: Crowding and solitude are important components of wilderness experience. Numerous studies explore the effect of encounters in wilderness settings as they affect the nature of visitor's experiences. Encounter rates are one vital part of the decision making matrix that would be used to review and possibly modify Yosemite's current overnight wilderness use limits.

Objectives: To assess crowding and opportunities for solitude as a component of wilderness experience quality in the upper Merced River corridor.

B.5.2. Sampling Design

This data will be collected primarily by the Merced Lake Ranger. Sampling will attempt to mimic, as much as possible, the visitor's experience, while recording the number of groups encountered. Data will be collected as part of routine patrols. Sampling times and locations will be dictated by patrol priorities rather than data needs. Temporal and spatial variation in data collection will be attained by combining several years' data and filtering for a variety of spatial and temporal characteristics. If more people can be devoted to data collection, they will be assigned to mitigate any deficiencies that result from this type of opportunistic sampling.

Rationale for sampling design: Most research on wilderness encounters considers encounters per day. A minority of visitors stay in the river corridor the entire day, however, so encounters are recorded by trail segment, with sampling time in the segment noted. While a more robust schedule based on sampling priorities would obviously be preferable, funding and other operational limitations dictate that sampling must be coincident with ranger patrols.

Site selection: The sampling area includes all zone 1A (un-trailed) and 1B (trailed) areas of the river corridor. A map of all indicator sampling locations is provided in the introduction to this field guide.

Trail segments sampled:

On trail (zone 1B):

- Moraine-Echo
- Echo-MLRS
- MLRS-Washburn
- Washburn-Junction

Off trail (zone 1A):

- Red Peak Fork
- Merced Peak Fork
- Lyell Fork
- South Fork

Sampling Schedule: The Merced Lake Ranger typically patrols the upper Merced Drainage from late May (depending on snowpack) to early October, and performs eight to nine day patrols during each two week period. Much of June is spent training in the frontcountry. Encounters will be recorded during regularly scheduled ranger patrols.

B.5.3 Field Methods

Data collection and measurement

- Data collectors should attempt to match their travel speed to that of a typical visitor, approximately two miles per hour.
- Whenever a data collector enters a new trail segment, the time will be recorded on the data sheet/index card. Any encounters within that zone will then be recorded. Staff should record an end time at the end of the zone or each time one needs to leave the trail to perform administrative duties.
- Data collectors will only count parties that are close enough to establish verbal or eye contact without leaving the trail. Parties camped close to the trail that can be seen and talked to from the trail will count. Each party will be counted only once, even if encountered multiple times. Parties found by leaving the trail to specifically look for campers or to perform other administrative tasks will not count. Other administrative parties (rangers, concession employees, etc.) will not be counted.
- If the data collector is unsure about whether individuals hiking separately are part of the same party, they will ask. This is already done as part of routine patrol.

When encounters with parties occur along a trail or are visible from the trail, record the following data on the data sheet provided:

- **Field Monitor Name(s):** Record field monitor name(s).
- **Date:** Day/Month/Year (August 8, 2005 = 08/08/05).
- **Start Time:** Record time entering trail segment or following a side trip off the trail.
- **End Time:** Record time leaving trail segment or when leaving trail.
- **Segment:** Record the trail segment number.
- **Number of Parties Encountered:** Record the number of parties encountered along segment of trail monitored.
- **Notes:** Record any information pertinent to the collection of data on that day in that particular site (i.e., weather, access issues, special events, etc.)

Figure B. 5.1 Data Sheet- Wilderness Encounters

Field Monitor Name:
Date:

Trail Segment*	Start Time	End Time	# of Parties Encountered

*Segments:			
1B Zone		**1A Zone**	
Moraine-Echo	1	Red Peak Fork	5
Echo-MLRS	2	Merced Peak Fork	6
MLRS-Washburn	3	Lyell Fork	7
Washburn-Jct.	4	South Fork	8
		Triple Peak Fork	9

Notes:

Post-collection and processing

- At the conclusion of the hike, the data should be transposed onto an Encounter Record Sheet, which should be filed until the end of the data collection period.
- Return data sheet/index cards to the wilderness management office and enter information in the Number of Encounters with other Parties database.

End of season procedures

- Data collectors should meet with the VERP Program Manager and Wilderness Specialist at the end of the season to discuss potential program improvements.

B.5.4. Data Management

Data entry: All data will be entered into the Number of Encounters with other parties database.

Data analysis: Questions remain on the best method of analysis for this indicator. Most of these concerns the difference between the units (encounters/day) used in most studies on the subject and the visitor use patterns found in zones 1A and 1B of the Merced River corridor: Most visitors spend only part of the day traveling in the sampling area. The best way to analyze the data to represent a visitor day across all temporal and spatial variables still needs to be decided.

Data reporting: Results from data analysis will be reported in the VERP annual report, at public meetings, and on the park website.

Data storage (meta data): Data will be stored in the wilderness patrol database.

B.5.5. Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): The Merced Lake Ranger will be the primary data collector. Other volunteers may be able to supplement this effort as available. Because this sampling occurs only during routine patrols; time commitment is minimal; training (1hour), data transfer (10 minute/day), data entry (2-3 hours for the season), and debriefing (1 hour).

The Wilderness Specialist and VERP Program Staff will be responsible for training data collectors (1 hour), providing logistics for any volunteers (3 hours each), quality control (1 3 day visit to the sampling area), debriefing (1 hour), and data analysis (1 day).

Qualifications: Data collectors must be competent at living and traveling in a remote wilderness setting. They also need to be able to record data accurately and maintain records accordingly.

Training procedures: The Wilderness Specialist, VERP Manager, or Wilderness Rangers with experience in recording encounters with parties will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Adjust hiking speed to approximate the typical speed of a visitor. Typical hiking speed would be approximately 2 miles per hour.
- Make appropriate recordings of encounter data on ranger patrol card.
- Enter data into the Number of Encounters database.

B.5.6 Operational Requirements

Work plan: Sampling will take place during the summer season, approximately mid June through mid October.
Safety: The job hazard analysis for this indicator is the same as for routine wilderness patrol.

Table B.5.1 Job Hazard Analysis-Wilderness Encounters

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Wilderness Encounters Monitoring	Yosemite Wilderness, YNP	
Job Hazard Analysis (JHA)	3. NAME OF ANALYST	4. JOB TITLE	5. DATE PREPARED
	Mark Fincher	Wilderness Mgr.	July, 2005
6. TASKS/PROCEDURES	7. HAZARDS	8. ABATEMENTS ACTIONS ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Walking, hiking and other physical exertion.	b. Exhaustion, muscle strain, dehydration and fatigue.	b. Drink plenty of fluids, bring snacks and/or meals if out during lunch hours, Take periodic rests and stretch before and after physical activity.	
c. Hiking and camping in Wilderness.	c. Bite or attack from snakes, bees and or wildlife. Exposure to poison oak.	c. Use appropriate backcountry hiking and camping techniques. Use appropriate backcountry gear and clothing. Carry park radio and first aid kit. Leave travel itinerary with supervisor.	
d. Working outdoors in cold and/or wet weather.	d. Hypothermia, reduced resistance to illness.	d. Wear appropriate clothing and carry extra layers. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
e. Working outdoors in hot / extreme heat weather.	e. Fatigue, exhaustion, dehydration and heat stroke.	e. Wear appropriate clothing and use sunscreen. Drink fluids and snack throughout the day. Carry extra water and dehydration salts along with first aid kit.	
10. SUPERVISORS SIGNATURE	11. TITLE	12. DATE	

Equipment and materials:
- Pencils / sharpener
- Watch
- Datasheet

Budget: To fully fund this indicator would require 5 months GS-7 (LE) pay. In addition, the Wilderness Specialist devotes approximately 10% of his time annually (at GS-9/7) to VERP.

B.5.7. References

Cole, David N.; Stewart, William P. 2002. Variability of user-based evaluative standards for backcountry encounters. Leisure Sciences 24: 313-324

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Newman, Peter. 2002. Integrating social, ecological, and managerial indicators of quality into carrying capacity decision making in Yosemite national Park wilderness.

Stewart, William P.; Cole, David N. 2001. Number of encounters and experience quality in Grand Canyon backcountry; consistently negative and weak relationships. Journal of Leisure Research 33(1): 106-120

Watson, Alan E.; Cronn, Rich; Christensen, Neal A. 1998. Monitoring inter-group encounters in wilderness. Res. Pap. RMRS-RP-14. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 20 p.

B.6. People At One Time (PAOT)

B.6.1 Background

In wild segments of the river, the Merced River Plan characterizes the recreational Outstandingly Remarkable Value as a "spectrum of levels for recreational use and opportunities for solitude with primitive and unconfined recreation." This indicator will allow managers to assess encounter levels and visitor satisfaction at selected day use picnic areas. Number of people at one time can also be used to assess levels of use, which can affect other Outstandingly Remarkable Values such as the biological, cultural, and scientific values set for the river corridor.

Description of indicator and standard
Indicator: For the Merced River PAOT monitoring serves as a "snap shot" of human use activity along the river. These snap shots reflect human use levels and behaviors that may potentially cause negative impacts such as crowding, user conflict, noise and others. PAOT data also serves as surrogate measures of overall human use in the river corridor and helps to protect the Merced River's Outstandingly Remarkable Values.
River Standard: No net increase from 2005 baseline of number of people in River Protection Overlay at selected sites.
Trail Standard: Not more than 20 people on a 50-meter section of the trail at one time, 80% of the time.
Attraction Site Standard: To be determined
Zone(s): 1C Heavy Use trail, 2A Open Space, 2A+ Undeveloped Open Space, 2B Discovery, 2C Day Use, 2D Attraction.

Rationale for indicator: Documenting visitor use levels is an essential component of a user capacity and related monitoring program. PAOT monitoring serves as an indicator of overall use concentrations at key sites. Crowding and congestion have been shown to degrade the quality of visitor experiences (Manning 1999) and can have a negative impact on park resources (Hammit and Cole 1998).

Objectives: To document the types and levels of human use at key areas along the river, along trails and at selected attraction sites within the Merced River Corridor.

B.6.2 Sampling Design

Rationale for sampling design: The People At One Time indicator is designed to estimate the density of people and visitor behaviors along the Merced River in Yosemite Valley. Since the potential for visitor satisfaction and number of people at one time influences Outstandingly Remarkable Values, both of these factors are addressed in this protocol. Monitoring will be conducted using a stratified sampling methodology to obtain a representative sample of day use activities across the days of the week and months during peak season from June to September. Three sampling locations are selected for the river and attractions sites representing high, medium and low use areas, while one sampling segment will be used along the trail. At each monitoring site the number of people present will be recorded at one time. Counting periods will be stratified by time of day between 8:00 a.m. and 8:00 p.m.

Measurement:
For PAOT along the river, the numbers of people present within a selected 50 meter segment of the river at one time.

For PAOT along the trail, the numbers of people present within a selected 50 meter segment of the trail at one time.

At PAOT attraction sites the number of people present, vehicles and behaviors at attraction sites within the Merced River corridor at one time will be measured.

Site selection (selection criteria and procedures):

1) Monitoring sites (River) - These areas were established in 2005 representing existing or future restoration areas, and/or reference areas by visitor use: the goal is to achieve a representative sample of high, medium and low use sites. The sites will be 50 meters in length, and span the width of the river and 15 m on either side of the banks. Using the 2005 baseline the river segment will be separated into high use, medium use and low use *sampling zones*. High use zones are characterized by their close proximity to bridges, parking lots/pull-offs, recreational areas such as lodges, campgrounds and picnic sites, while medium use zones and low use zones receive substantially lower level of use, though highly localized high use may occur.

2) Monitoring Sites (Trail) - This area was established in 2004 due to the exceptionally high volume of hikers along the Mist trail: the goal is to achieve a representative sample of a high use trail segment. Additionally, this site was used in a study of visitor study conducted in 1998 (Manning et al. 1998) exploring for visitor's normative evaluations of PAOT encounters. The trail segment will be 50 meters in length.

3) Monitoring Sites (Attraction Sites) - These day use areas were established in 2005 by visitor use: the goal is to achieve a representative sample of high, medium and low day use sites. High use zones are characterized by their close proximity to bridges, parking lots/pull-offs, recreational areas such as lodges, campgrounds and picnic sites, while medium use zones and low use zones receive substantially lower level of use, though highly localized high use may occur.

Sampling Schedule: Sample sizes were determined using a 95% confidence interval and will represent the mean PAOT of one minute intervals. This is based on the assumption that there are approximately 54,000 minutes of the summer use season. Field work for this indicator will be conducted on mornings and afternoons for weekdays, weekends and holidays during peak season from June to September. Sampling should capture early and late day visitors utilizing the Merced River. This schedule provides a total of 12 normal weekday samples and 2 holiday weekday samples, as well as 12 normal weekend samples and 2 holiday weekend samples. Monday-Thursday constitutes weekdays, while Friday-Sunday constitutes weekend days. Sampling will represent a one hour period, making counts for every minute in the hour. Mornings will be the time period between 8:00 a.m. and 12:00 p.m. While afternoons will be from 12:00 p.m. to 8:00 p.m. Efforts should be made to sample early and late daily and seasonally. That is, time of sampling day should rotate throughout the sampling schedule. For example, if you sample from 10-11 on one day, sample 11-12 on the next sample day. Set up a schedule that rotates sampling period in order to represent various hours of the morning and afternoon, see Figure B.6.1. Sample sizes are summarized in Table B.6.1.

Table B.6.1 Sample Sizes for People At One Time

Type of Sample	*# of One Minute Counts*
Weekday Morning	360
Weekday Afternoon	360
Weekend Morning	360
Weekend Afternoon	360
Holiday Weekday Morning	60
Holiday Weekday Afternoon	60
Holiday Weekend Morning	60
Holiday Weekend Afternoon	60

Figure B.6.1. Example of a sampling schedule for People At One Time along the Merced River for 2006 season.

June						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21 Weekday Sample Morning	22	23	24 Weekend Sample Morning	25
26 Weekday Sample Afternoon	27	28	29	30 Holiday Weekend Sample Afternoon		

July						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
					1	2
3	4 Holiday Weekday Sample Morning	5	6	7	8	9 Weekend Sample Afternoon
10	11	12	13 Weekday Sample Afternoon	14	15	16 Weekend Sample Morning
17	18	19 Weekday Sample Morning	20	21 Weekend Sample Afternoon	22	23
24	25	26 Weekday Sample Afternoon	27	28	29 Weekend Sample Afternoon	30
31 Weekday Sample Afternoon						

August						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
	1	2	3	4	5	6 Weekend Sample Afternoon
7	8 Holiday Weekday Sample Afternoon	9	10	11	12	13 Weekend Sample Morning
14	15	16	17 Weekday Sample Morning	18	19	20
21 Weekday Sample Morning	22	23	24	25 Weekend Sample Afternoon	26	27
28	29	30	31 Weekday Sample Afternoon			

September						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
				1 Holiday Weekend Sample Morning	2	3
4	5 Holiday Weekday Sample Afternoon	6	7	8	9 Weekend Sample Afternoon	10
11	12	13 Weekday Sample Morning	14	15 Weekend Sample Afternoon	16	17
18	19 Weekday Sample Morning	20	21	22	23	24 Weekend Sample Morning
25	26	27	28	29	30 Weekend Sample Morning	

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B.6.3 Field Methods

Preparation: Field personnel should be trained (see Training section below) and the following required tools and supplies should be acquired.

- Map with location, photos and directions to monitoring sites
- Field Forms: Data sheets on waterproof paper
- Clipboard/pencils/pens
- Watch with second hand (stopwatch optional)
- Counter
- Sunscreen/insect repellant/first aid kit
- Water

Data collection: Data collection procedures for People At One Time and their methods are described below:

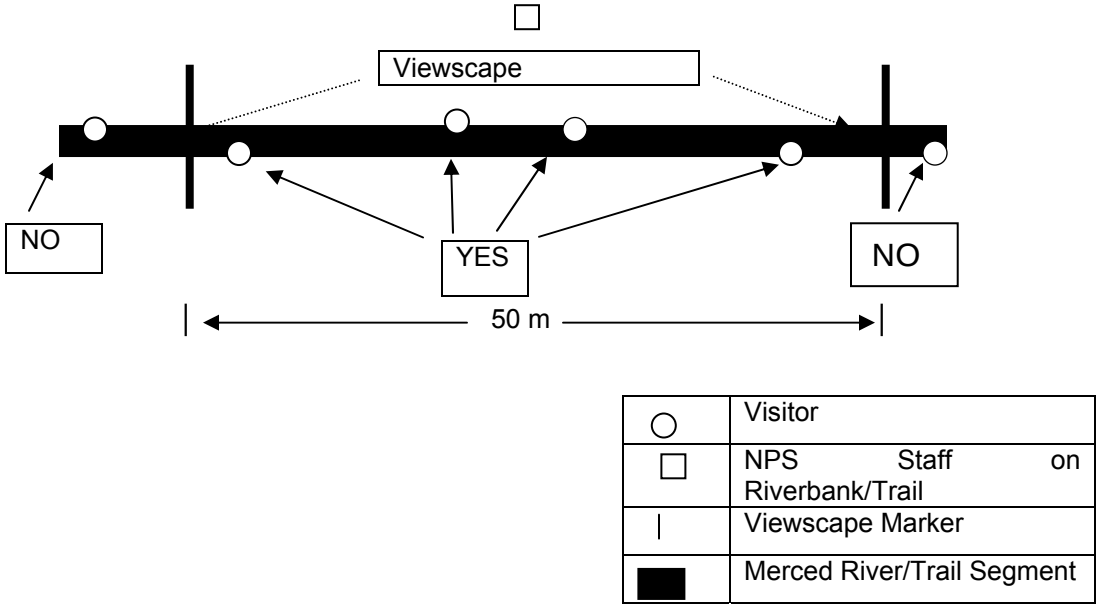
1) **Monitoring sites (River)**
   - Locate monitoring site using map, directions and photos.
   - Identify two natural viewscape makers along the river section, 50 meters apart.
   - The Data Collector will then station himself or herself in a position that permits vision of the complete viewscape in the river segment and low visitor interaction levels. This is illustrated in Figure B.6.2. Viewscape also extends 15 meters on either side of the river bank. The Data Collector should be clothed in normal attire to maintain 3rd party observational anonymity.
   - The Data Collector should record the amount of people visible in the viewscape at the beginning of each minute, every minute for an hour. For example, if four people are present in the viewscape at 12:01:00 pm, and another walks in at 12:01:03 pm, the staff member should record 4 in the PAOT field data sheet. Figure 6-3 illustrates a completed field data sheet.
   - When hour of monitoring has been completed at a given location, proceed to the next location on the monitoring circuit. The monitoring circuit should be rotated throughout the season.
   - This data should be collected on weekdays and weekends, during the morning and afternoon. It is also important to note whether or not the day in question is a holiday.
   - When monitoring is complete, return all datasheets to the designated drop-box in the Public Information Office (PIO) in the Administration Building.

2) **Monitoring sites (Trail)**
   - Locate monitoring site using map, directions and photos.
   - Identify two natural viewscape makers along the trail segment, 50 meters apart.
   - The Data Collector will then station himself or herself in a position that permits vision of the complete viewscape in the trail segment and low visitor interaction levels. This is illustrated in Figure B.6.2. The Data Collector should be clothed in normal attire to maintain third party observational anonymity
   - The Data Collector should record the amount of people visible according to activity and their behavior in the viewscape at the beginning of each minute, every minute for an hour. For example, if four people are present in the viewscape at 12:01:00 pm, and another walks in at 12:01:03 pm, the staff member should record 4 in the PAOT field data sheet. Figure B.6.4 illustrates a completed field data sheet.
   - This data should be collected on weekdays and weekends, during the morning and afternoon. It is also important to note whether or not the day in question is a holiday.
   - When monitoring is complete, return all datasheets to the designated drop-box in the Public Information Office (PIO) in the Administration Building.

3) **Monitoring sites (Attraction Sites)**
   - Locate monitoring site using map, directions and photos.
   - Each attraction site will be monitored ever hour on the ½ hour.
   - Arrive at the selected attraction site and park the vehicle.

- For the Cascade and Texas Flat day Use area, the Data Collector will count all vehicles, buses, visitors and available picnic tables.
- For the Sentinel Beach monitoring site, the Data Collector, starting in a loop will count all available picnic tables. The Data Collector will then take a second loop around the attraction site, counting all visitors and vehicles.
- The Data Collector should be clothed in normal attire to maintain 3rd party observational anonymity.
- The Data Collector should record the numbers in the PAOT field data sheet. Figure B.6.5 illustrates a completed field data sheet.
- When monitoring has been completed at a given location, proceed to the next location on the monitoring circuit.
- This data should be collected on weekdays and weekends, during the morning and afternoon. It is also important to note whether or not the day in question is a holiday.
- When monitoring is complete, return all datasheets to the designated drop-box in the Public Information Office (PIO) in the Administration Building.

Figure B.6.2 Example of Viewscape on River or Trail Segment along the Merced River Corridor.



4) Data Sheet Procedures (River)

- **Field Monitor Name (s):** Record field monitor name(s).
- **Date:** Month/Day/Year (May 30, 2006 = 5/30/06).
- **River Segment:** Record the river segment where the monitoring was conducted.
- **Day of Week:** Record the day that the monitoring occurred.
- **Holiday:** Record whether or not the monitoring occurred on a holiday.
- **Time:** The time will be recorded each minute during an hour-long monitoring session.
- **Number of People:** Record the number of people observed in the viewscape for that minute according to activity (float, fish, swim, walk or other).
- **Notes:** Record any field noted or observations pertinent to data collection on day of sampling, such as weather conditions.

5) Data Sheet

Figure B.6.3Figure B.6.3 PAOT RIVER DATASHEET (2006)

Name:				Date:		River Segment:					
Weekday / Weekend (circle one): WD WE						Holiday (circle one): YES NO					
TIME:	# of People in Viewscape:					TIME:	# of People in Viewscape:				
	Float	Fish	Swim	Walk	Other		Float	Fish	Swim	Walk	Other
Notes:											

6)Data Sheet Procedures (Trail)

- **Field Monitor Name (s):** Record field monitor name(s).
- **Trail Segment:** Record the trail segment where the monitoring was conducted.
- **Date:** Month/Day/Year (May 30, 2006 = 5/30/06).
- **Day of Week:** Record the day that the monitoring occurred.
- **Holiday:** record whether or not the monitoring occurred on a holiday.
- **Time:** The time will be recorded each minute during an hour-long monitoring session.
- **Number of People:** Record the number of people observed in the viewscape for that minute according to the activity.
- **Behavior:** Observe and record data reflecting visitors behaviors, coded in the datasheet.
- **Notes:** Record any field noted or observations pertinent to data collection on day of sampling, such as weather conditions.

7) Data Sheet – Figure B.6.4

Figure B.6.4 PAOT TRAIL DATASHEET 2006

Name:		Date:		Trail Segment:	
Weekday / Weekend (circle one): WD WE			Holiday (circle one): YES NO		
TIME:	# of People:		TIME:	# of People:	
	Hike	Backpack		Hike	Backpack
:00			:30		
:01			:31		
:02			:32		
:03			:33		
:04			:34		
:05			:35		
:06			:36		
:07			:37		
:08			:38		
:09			:39		
:10			:40		
:11			:41		
:12			:42		
:13			:43		
:14			:44		
:15			:45		
:16			:46		
:17			:47		
:18			:48		
:19			:49		
:20			:50		
:21			:51		
:22			:52		
:23			:53		
:24			:54		
:25			:55		
:26			:56		
:27			:57		
:28			:58		
:29			:59		
Behavioral Codes: (A) = Large group (B) = Noise (C) = Litter / trash (D) = Off trail use (E) = Other (please specify)			**Exhibited Behaviors:**		

8)Data Sheet Procedures (Attraction Sites)

- **Field Monitor Name (s):** Record field monitor name(s).
- **Date:** Month/Day/Year (May 30, 2006 = 5/30/06).
- **Site:** Record the day use area where the monitoring was conducted.
- **Number of Picnic Tables:** The current number of picnic tables at that attraction site.
- **Day of Week:** Record the day that the monitoring occurred.
- **Holiday:** Record whether or not the monitoring occurred on a holiday.
- **Time:** The time will be recorded the beginning of each monitoring session.
- **Number of People:** Record the number of people observed in at attraction site for that time period.
- **Number of Vehicles/Buses:** Record the number of vehicles and/or buses observed at the attraction site for that time period.
- **Number of Available Picnic Tables:** Record the number of available picnic tables observed at the attraction site for that time period.
- **Observed Behavior:** Observe and record data reflecting visitors behaviors, coded in the datasheet.
- **Notes:** Record any field noted or observations pertinent to data collection on day of sampling, such as weather condition

9) Data Sheet - Figure B.6.5

Figure B.6.5 PAOT Attraction Sites DATASHEET 2006

Name:		**Date:**	
Site: Sentinel Beach Picnic Area		**Number of picnic tables: 12**	
Weekday / Weekend (circle one): WD WE		**Holiday (circle one): YES NO**	
TIME:	**# of People**	**# of Vehicles**	**# of available picnic tables**
Behavioral Codes: (A) = Large group (B) = Noise		**Observed Behaviors:**	
Notes:			

10) Datasheet - Figure B.6.6

Figure B.6.6 PAOT Attraction Sites DATASHEET 2006

Name:		**Date:**	
Site: Texas Flat Picnic Area		**Number of picnic tables: 5**	
Weekday / Weekend (circle one): WD WE		**Holiday (circle one): YES NO**	
TIME:	**# of People**	**# of Vehicles**	**# of available picnic tables**

Behavioral Codes: (A) = Large group (B) = Noise (C) = Litter / trash (D) = User conflicts (please specify) (E) = Other (please specify)	**Observed Behaviors:**

Notes:

11) Datasheet - Figure B.6.7

Figure B.6.7 PAOT Attraction Sites DATASHEET 2006

Name:			**Date:**	
Site: Cascade Picnic Area			**Number of picnic tables:** 7	
Weekday / Weekend (circle one): WD WE			**Holiday (circle one): YES NO**	
TIME:	**# of People**	**# of Vehicles**	**# of Buses**	**# of available picnic tables**

Behavioral Codes: (A) = Large group (B) = Noise (C) = Litter / trash (D) = User conflicts (please specify) (E) = Other (please specify)	**Observed Behaviors:**

Notes:

Post-collection and processing: Datasheets will be returned to the designated drop-box in the Public Information Office (PIO) in the Administration Building. Datasheets will then be copied and stored in the VERP program office in Yosemite Valley.

B.6.4 Data Management

Data Entry: Collected data will be entered by data collection staff into the PAOT databse, and any digital photographs will be labeled and filed electronically. Field notes will be transferred into digital form (i.e. word processed).

Data analysis: PAOT will be analyzed using statistical means and incorporated into summary tables. Data should be presented by sampling location (high, medium, or low). The average PAOT by minute and per hour may be used.

Data reporting: PAOT will be presented in the 2006 VERP Annual Report.

Data storage: All collected data and compiled documentation will be stored on the YOSE NPS network (ms01/EP Commons/VERP/VERP Data Management/PAOT). GIS maps and project files can be found at (ms01/ EP Commons/VERP/VERP Data Management/Maps/YOSE Park Map 2003). Datasheets can be found at (ms01/ EP Commons/VERP/VERP Field Logistics/PAOT/PAOT River/PAOT Datasheet) and originals will be stored in the VERP office in Yosemite Valley.

B.6.5 Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): Supervisory GS-7 responsible for oversight of field work and training of personnel not familiar with protocol and surveying. GS-7 field technician in charge of tasks associated with PAOT surveys and training and supervising other field staff. Other field staff will assist in surveying PAOT.

Projected personnel needs for PAOT monitoring locations are 2 to 3 personnel for 16 weeks (including training), with each site requiring one weekday and one weekend per week. The river site will require a total of 4 hours, to include time for travel. A total of 2 to 3 hours will be needed to monitor the trail segment to allow for hiking. Each attraction site will require ten to fifteen minutes every hour for 6 hours.

Qualifications: Data Collectors will be required to demonstrate the ability to accurately count the number of visitors within the Merced River corridor and enter data into PAOT database. All Data Collectors will be required to work outdoors during inclement weather, stand for extended periods of time and may be required to hike or walk for long distances.

Training procedures: Two days will be dedicated to familiarizing field staff with indicator and protocol.

B.6.6 Operational Requirements

Work plan: Sampling will take place during the summer season from mid June to mid September.

Safety: A job hazard analysis has been completed and appears below (Table B.6.2).

Table B.6.2 Job Hazard Analysis for PAOT Data Collection

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP PAOT Monitoring	Yosemite Valley, YNP	
Job Hazard Analysis (JHA)	3. NAME OF ANALYST	4. JOB TITLE	5. DATE PREPARED
	Jim Bacon	Technician	July, 2005
6. TASKS/PROCEDURES	**7. HAZARDS**	**8. ABATEMENTS ACTIONS ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE**	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Walking, hiking and other physical exertion.	b. Exhaustion, muscle strain, dehydration and fatigue.	b. Drink plenty of fluids, bring snacks and/or meals if out during lunch hours, Take periodic rests and stretch before and after physical activity.	
c. Hiking through and working in meadows.	c. Inclement weather, heat, dehydration; poison oak; insects and snakes.	c. Dress appropriately, drink plenty of fluids, bring snacks and/or meals if out during lunch hours, carry first-aid kit including snake-bite kit and Tecnu, in case of contact with poison oak. An Epy pen may be necessary to carry as well.	
d. Working and walking along riverbanks.	d. Tripping and/or falling due to wet and slippery rocks or sloping ground surfaces, contact with poison oak, etc.	d. Watch footing, know how to identify and avoid all poison oak, rinse immediately in stream if contact occurs.	
e. Working outdoors in cold and/or wet weather.	e. Hypothermia, reduced resistance to illness.	e. Wear appropriate clothing and carry extra layers. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
f. Working outdoors in hot / extreme heat weather.	f. Fatigue, exhaustion, dehydration and heat stroke.	f. Wear appropriate clothing and use sunscreen. Drink fluids and snack throughout the day. Carry extra water and dehydration salts along with first aid kit.	
g. Hiking in Wilderness.	g. Bite or attack from snakes, bees and or wildlife. Exposure to poison oak.	g. Use appropriate backcountry hiking and camping techniques. Use appropriate backcountry gear and clothing. Carry park radio and first aid kit. Leave travel itinerary with supervisor.	
10. SUPERVISORS SIGNATURE	**11. TITLE**	**12. DATE**	

Equipment and materials:

- Map with location, photos and directions to monitoring sites
- Field Forms: Data sheets
- Clipboard/pencils/pens
- Watch with second hand (stopwatch optional)
- Hand Counter
- Sunscreen/insect repellant/first aid kit
- Water

Budget:

Supervisory GS-07 $16.83/hr * 28 hours = $471.21
Field Technician River/Trail GS-05 $13.58/hr * 224 hours (16 hours/week * 14 weeks) = $ 3041.92
Field Technician Sites GS-05 $13.58/hr * 204 hours = $2270.32
Total $6555.00

6.7 References:

Hammit, W. and D. Cole (1998) Wildland Recreation. 2nd ed. John Wiley & Sons, Inc.

Manning, R., B. Wang, W. Valliere, and S. Lawson. 1998. Carrying Capacity Research for Yosemite Valley: Phase I Study. Burlington, Vermont: University of Vermont.

Manning, R., W. Valliere, S. Lawson, B. Wang, and P. Newman. 1999. Carrying Capacity Research for Yosemite Valley: Phase II Study. Burlington, Vermont: University of Vermont.

Manning R. (1999) Studies in Outdoor Recreation. 2nd ed. Oregon State University Press. OR. Corvallis.

B.7. Parking Availability

B.7.1. Background

Traffic congestion in Yosemite Valley has been a well documented issue for many years. In fact, the reduction of traffic congestion was one of the primary goals of the 1980 General Management Plan (YOSE 1980). The number of vehicles in activity areas directly affects visitor experience (part of the recreational Outstandingly Remarkable Value) (Littlejohn et al. 2006, White et al. 2006). When the number of vehicles exceeds the supply of appropriate parking, drivers often resort to parking along the roadside and in other inappropriate areas (Thomas et al. 2005; Elliot et al. 2006). As a result, resources may be adversely affected. Therefore, it is important to define the point when these values become most at risk of degradation. It has been determined that these risks occur significantly when designated parking areas fill to capacity and staff perform Alternative Parking Measures (APM) to alleviate congestion and stopped traffic flows. Alternative parking actions are defined as the point when the Camp 6 day use parking lot is full and traffic staff begins directing people to park along the roadside or other alternative areas. Monitoring day use parking capacity provides park management with an indication that visitor use levels and corresponding vehicular use have reached unacceptable levels that may be causing unacceptable impacts to park resources and the quality of visitors' experiences.

Description of indicator and standard:

Indicator: Number of instances and length of time day use parking area fills to capacity and alternative parking measures are implemented.

Standard: NOTE: Standards for this indicator are under consideration, but will likely read as follows: The number of instances (time) when designated parking is full (requiring alternative parking actions) will occur on no more than X days per year (season) and X hours on average/day.

Zone(s): 2C Day Use; 3B Visitor Base and Lodging

Rationale for indicator: Transportation has long played an important role in the National Park system (Percival 1999). Transportation issues have recently been studied at such parks as Yellowstone (Mings et al. 1992), Smoky Mountains (Sims et al. 2005), Blue Ridge Parkway (Vallier et al. 2003) as well as in Yosemite (Nelson and Tumlin 2000, YOSE 1999, White et al. 2006). Traffic congestion was identified in the Yosemite Valley Plan as one of the principal human use impacts to mitigate (YOSE 2000).

Thousands of vehicles enter Yosemite Valley each year, resulting in significant traffic congestion. Traffic congestion can cause a variety of impacts to natural and cultural resources as well as the quality of the visitor experience. Specific impacts include increased travel and waiting times, wildlife depredation, air pollution, noise, vegetation loss, and others. Parking availability serves as an indicator of overall traffic congestion in Yosemite Valley and, therefore, serves as an early warning sign suggestive of the extent to which human vehicular use is negatively affecting the park.

Objective: Provide expedient and accurate assessment of parking capacity at the Camp 6 day use parking area as an indicator of overall human vehicular use levels in Yosemite Valley.

B.7.2. Sampling Design

Two sampling strategies will be employed to monitor parking availability in 2006. First, a daily log will be kept documenting the instances that the Camp 6 day use parking area fills to capacity and is closed. This will provide information as to the frequency and duration of parking area closures. In addition, vehicular use at three other parking areas will be monitored in 2006. These include the backpacker's lot, curry orchard lot, and the Yosemite Lodge bus lot. Collectively, these areas, along with camp 6 represent the principal parking

areas in Yosemite Valley. Measuring and monitoring their use will provide a more comprehensive view of overall parking capacity.

In order to obtain more detailed information about the parking behaviors at these sites, a second sampling methodology will be employed. This method will involve conducting detailed counts of parking behaviors at the Camp 6 lot including vehicle type, duration of stay, and overall vehicle count.

Sampling schedule: The following is a sampling schedule for the parking behaviors data collection. All other data collection will be conducted on a daily basis using a log as shown in the data sheets section below.

Figure B.7.1 Example of Sampling Schedule for Parking Availabilty

July						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20 Weekday Sample	21 Weekday Sample	22	23
24	25	26	27	28	29 Weekend Sample	30 Weekend Sample
31						

August						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17 Weekday Sample	18 Weekend Sample	19	20
21	22	23	24	25	26 Weekend Sample	27 Weekend Sample
28	29 Weekday Sample	30 Weekday Sample	31			

B.7.3. Field Methods

Data collection and measurement: The following list describes the variables for which data will be collected at all parking locations.

- **ID:** Enter case identification number in ascending order beginning with "1".
- **Date:** Enter date of sample as follows (e.g. 10/21/06)
- **Weekday / Weekend:** Enter "WD" for weekday or "WE" for weekend. For the purposes of this monitoring effort weekdays are considered to be Monday through Thursday and weekends are considered to be Friday, Saturday and Sunday.
- **Holiday:** Record "Y" for yes if it is a holiday or "N" if it is not a holiday.
- **Directed:** Record a "Y" for yes if parking was directed on the day of sampling or "N" for no, it was not directed on the sampling day.
- **Time Initiated:** Record the time Alternative Parking Measure (APM) was initiated (e.g. 0900)
- **Time Terminated:** Record the time Alternative Parking Measure (APM) was terminated (e.g. 1032)
- **Time In:** Enter the time the bus entered the loading area at Yosemite Lodge (e.g. 0830)
- **Time Out:** Enter the time the bus left the loading area at Yosemite Lodge (e.g. 1130)
- **Bus Company Name:** Enter the name of the bus company
- **License Plate #:** Enter the license plate number of the vehicle / bus
- **State:** Record the state from the license plate on the bus
- **# of Passengers:** Record the number of passengers on the bus
- **Closure VOG**: Record the number of Vehicles on the Ground (VOG) at the time the Alternative Parking Measure (APM) was initiated.
- **Record other Factors**: Record other factors that may have lead to APM (gate back-ups, road closures due to accidents or fire, back ups at the entrance gate, etc.)
- **Total Vehicles In**: Record the total number of vehicles that entered the parking area from the traffic counter at the parking area entrance.
- **Vehicles Parked at Sampling Times:** Record the total number of vehicles by type – Motorcycle, Automobile, or Campers / Trailers
- **Comments:** Record any field notes or observations pertinent to data collection on day of sampling.

Figure B.7.2 Parking Availability Datasheets

Yosemite National Park
VERP Parking Capacity Indicator 2006

CAMP 6

ID	Date	Weekday / Weekend	Holiday	Directed	Closure Start Time	Closure End Time	Closure VOG	Comments
		(WD / WE)	(Y / N)	(Y / N)				
e.g.	*5/4/06*	*WD*	*N*	*N*	*14:00*	*17:00*	*540*	*rain*

Yosemite National Park
VERP Parking Capacity Indicator 2006

CURRY ORCHARD

ID	Date	Time	Weekday / Weekend (WD / WE)	Holiday (Y / N)	Directed (Y / N)	Total Vehicles In	Comments
e.g.	*5/4/06*	*11:00*	*WD*	*N*	*N*	*540*	*rain*

Yosemite National Park
VERP Parking Capacity Indicator 2006

Backpacker's Lot

ID	Date	Weekday / Weekend (WD / WE)	Holiday (Y / N)	Directed (Y / N)	Closure Start Time	Closure End Time	Closure VOG	Comments
e.g.	*5/4/06*	*WD*	*N*	*N*	*14:00*	*17:00*	*540*	*rain*

Yosemite National Park
VERP Parking Capacity Indicator 2006

BUS LOTS

ID	Date	Time	Weekday / Weekend (WD / WE)	Holiday (Y / N)	Directed (Y / N)	Total Buses In	Comments
e.g.	*5/4/06*	*11:00*	*WD*	*N*	*N*	*540*	*rain*

Yosemite National Park
VERP Parking Capacity Indicator 2006

Sampling Form

Location:		Weekday / Weekend:	Circle one: WD WE
Date:		Holiday:	Circle one: YES NO

Time	Vehicles Parked at Sampling Times			Comments
	Motor-cycles	Automobiles	Campers / Trailers	
16:30	*45*	*750*	*100*	*rain*

Yosemite National Park
VERP Parking Capacity Indicator 2006

Sampling Form

Space ID	Time	License Plate	Comments
e.g.	*8:15*	*CA 123-345*	*rain*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Space ID	Time	License Plate	Comments
e.g.	*9:15*	*CA 123-345*	*rain*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

B.7.4. Data Management

Data entry: Data will be entered into a database by traffic management staff on a monthly basis. VERP Monitoring Program staff will re-code a selected sample of datasheets to ensure quality of data entry. Discrepancies between data coding will be reconciled using the completed datasheets.

Data analysis: Data will be analyzed using statistical software (either Statistical Package for the Social Sciences – SPSS or JMP). Descriptive statistics will be used to present frequency distributions of the data. The length of time of parking area closures should be analyzed using both the mean and median of the distribution.

Data reporting: Results will be compiled and presented in the VERP Annual Report. Additionally, information will be presented at a public meeting and made available on the park's website.

Data storage (metadata): Data will be stored electronically on the MS10 server in the Yosemite National Park computer directory. Hard copies of completed datasheets will remain on file with the Integrated Resources Analysis Branch in El Portal. These copies should be stored in a fire-safe area. The life cycle should be 3 years for printed materials after which time all data and report should be physically and electronically archived to allow for future longitudinal analysis and documentation.

B.7.5. Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): VERP monitoring program personnel will work collaboratively with traffic management staff in the Protection Division to conduct monitoring activities. Daily logs will be kept by traffic management staff and the detailed sampling of parking areas will be conducted by VERP program staff.

Qualifications: Data collection personnel should be capable of working outdoors for extended periods of time. They should be able to carryout basic mathematical exercises and document results accordingly. Personnel should also exhibit the ability to conduct activities in a varied and complex setting where multiple tasks may be required at the same time.

Training: Monitoring personnel will be trained jointly by the traffic manager and VERP monitoring program staff on the procedures and methods of data collection. Training will consist of an explanation of data collection procedures and a trial run-through collecting mock data. Once personnel have been trained and data are being collected, VERP monitoring program staff will conduct field visits to ensure that data continue to be collected properly and to conduct additional training or troubleshoot problems should they arise over the course of the data collection effort.

Safety: Particular attention will need to be given to collecting data in a safe manner as personnel will be working in close proximity to moving vehicles. A job hazard analysis has been completed and appears below (Table B.7.1.).

Table B.7.1 Job Hazard Analysis for Parking Availability Data Collection

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Transportation Monitoring	Yosemite Valley, YNP	
Job Hazard Analysis (JHA)	3. NAME OF ANALYST	4. JOB TITLE	5. DATE PREPARED
	Dave Henderson	Facilities Mgr.	June, 2006
6. TASKS/PROCEDURES	7. HAZARDS	8. ABATEMENTS ACTIONS ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Standing, walking, hiking and other physical exertion.	b. Exhaustion, muscle strain, dehydration and fatigue from prolonged standing or physical exertion.	b. Drink plenty of fluids, bring snacks and/or meals if out during lunch hours, Take periodic rests and stretch before and after physical activity.	
c. Working outdoors in cold and/or wet weather.	c. Hypothermia, reduced resistance to illness.	c. Wear appropriate clothing and carry extra layers. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
d. Working outdoors in hot / extreme heat weather.	d. Fatigue, exhaustion, dehydration and heat stroke.	d. Wear appropriate clothing and use sunscreen. Drink fluids and snack throughout the day. Carry extra water and dehydration salts along with first aid kit.	
10. SUPERVISORS SIGNATURE	11. TITLE	12. DATE	

B.7.6 Operational Requirements

Work plan: Monitoring efforts associated with the parking capacity indicator should follow a general work plan as presented in Table X in the introduction to this field guide. Generally, two traffic management seasonal staff (wage grade) will be used to collect data. Data will need to be collected between May and October, or the peak season of visitor use in the park.

Equipment and materials:

- Clipboard
- Pencils / sharpener
- Data sheet
- Instructions for data sheet
- Watch
- Hand counter(s)
- 6 pneumatic traffic counting tubes

Budget: The following is a suggested budget for carrying out data collection efforts associated with this indicator in 2006. (NOTE: This budget does not reflect actual costs)

Item	Cost	Quantity	Total
Personal Services			
Data collection lead (GS-09)	$27.44	360 hours	$9,878.40
Data collector1 (GS-04)	$16.19	480 hours	$7,771.20
Data collector2 (GS-04)	$16.19	480 hours	$7,771.20
Equipment and Supplies			
Misc. office (clipboards, pencils, hand-counters, etc.)	$100.00	-	$100.00
Traffic counters	$200.00	5	$1,000.00

B.7.7 References

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B.8. Usability of Ethnobotanical Resources

B.8.1. Background

Ethnobotany is considered to encompass all studies which concern the mutual relationship between plants and traditional peoples (Cotton 1996). Plants have been used by native peoples for thousands of years for medicine, food, shelter, textiles, tools, and many other purposes (Ruppert 2001). Traditional plant gathering by indigenous populations is increasingly being recognized as an integral part of the cultural and natural significance of protected areas (Cotton 1996; Balick 1996; Pieroni 2006).

The Merced River corridor has many culturally Outstandingly Remarkable Values including historic structures, archeological sites, and significant American Indian presence. Both historically and contemporarily, the Miwuk Indians have played a significant role in the Merced River ecosystem. Through their traditional management of plant communities, they have helped to shape the landscape of the river corridor as we know it today. Their heritage can be found in archaeological caches and still today in their traditional practices. An integrated indicator was formulated in 2005 to address this latter cultural significance of the river corridor.

The Miwuk Indians have traditionally gathered a variety of flora found in the Merced River corridor. These gathered objects are used in traditional basketry, for medicinal purposes, for food, and in play. The continuation of these traditional gathering practices and preservation of plant populations utilized by the Miwuk Indians is essential for the preservation of this outstanding cultural resource in the Merced River corridor.

This field guide presents the proposed procedures, data requirements, and data collection sheets for conducting monitoring of the usability of selected ethnobotanical resources within the Merced River Corridor. These resources are considered a part of the Merced River's cultural Outstandingly Remarkable Value because they are intricately associated with the river corridor as human habitat. The specific locations of the plant resources are protected by confidentially clauses in the National Historic Preservation Act (NHPA) of 1966, the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, and the American Indian Religious Freedom Act of 1978 (16 U.S.C 4321 et seq., 25 U.S.C 3001 et seq., and 42 U.S.C., respectively).

Confidentiality and anonymity of plants and their uses as well as the traditional Practitioner will be maintained and given consideration on all levels of this project. Site locations will also be afforded the same considerations.

Four plant species that are in use today for education, retention, and transmittal of the American Indian culture that are found in the Merced River corridor have been selected for this indicator. These include *Pteridium aquilinum*, *Sambucus Mexicana*, *Asclepias speciosa*, and *Cercis occidentalis*. These four species were chosen because of their importance to Miwuk cultural practices, tendency to experience impacts from visitors, and representation of the spectrum of traditional uses.

The following protocol and criteria for usability of plants was developed through a dialog between American Indian Practitioner representatives and National Park Service scientists to address this component of the Traditional Plant Resources indicator.

Description of indicator and standard
Indicator: Usability of four traditionally gathered plant species:

- Bracken fern (*Pteridium aquilinum*) in Yosemite Valley; fiddleheads are a traditional food source, and filaments in the rhizomes are used in basket weaving.
- Blue elderberry (*Sambucus mexicana*) in canyonsides of the Merced River; berries are used for food, and stems are used in games and for musical instruments.
- Showy milkweed (*Asclepias speciosa*) in Yosemite Valley; stalk fibers used as cordage (representative Indian Hemp species).
- Redbud (*Cercis occidentalis*) in El Portal; used in basket weaving.

Standard: No net decrease in Practitioner usability of the four plant species over baseline (from 2005 assessment), and no damage to plant species caused by visitor use. Quantitative standards will be set through continued consultation with practitioners.

Zones: Zone 2B Discovery, Zone 2C Day Use, Zone 2D Attraction

Rationale for indicator: Usability and condition of ethnobotanical resources in Yosemite Valley, a site listed as a Traditional Cultural Property based on Criterion in National Register Bulletin #38, are at risk for potential impact that could alter their qualifying characteristics from erosion and trampling by visitor use on social trails in 2B and 2C zones, park and concessionaire employee private residential use and maintenance, park and concessionaire operations and maintenance, and limited funding for resource management to control and manage nonnative species encroachment to traditional plant habitat.

Objectives: To document and facilitate the assessment by local American Indian Practitioners of the usability and condition of four representative plant species that are in use today for education, retention, and transmittal of the American Indian culture.

B.8.2 Sampling Design

Rationale for sampling design: There is very little documented experience and published literature available that can provide guidance on monitoring ethnobotanical resources. 2005 was the pilot season for this indicator, and much time and energy were invested in developing a solid foundation for monitoring with a few representative traditionally used plant species and populations in Yosemite Valley. The integrated nature of this indicator allowed for the cooperation of many divisions within the park and the local American Indian community. We established a working dialog with the Southern Miwuk Tribe, and met regularly to discuss species and site selection, monitoring issues and concerns, and data collection. Last year's monitoring consisted of both scientific and practitioner assessments on selected species. However, during off-season workgroup meetings on the effectiveness of this approach, it was decided that the aim of this indicator should be cultural and, therefore, focus on practitioner experience. The assumption was made that the usability of traditional plant resources was linked to the overall health and condition of the plant populations, and therefore a practitioner assessment of usability would also address basic plant condition. In the 2005 season, the Practitioner assessment protocol was piloted on two plant species, blue elderberry (*Sambucus mexicana*) and redbud (*Cercis occidentalis*). Since these monitoring efforts were successful, the Practitioner assessment will be expanded to all four species investigated in the 2005 season: adding bracken fern (*Pteridium aquilinum*) and showy milkweed (*Asclepias speciosa*).

Site selection:
Site selection (accomplished in 2005) was based on the following criteria:

- Practitioner identification of maintained species populations (those currently used, or those used previously that could potentially support future use)
- Populations that have been affected or are being threatened by visitor use

- The size of habitat can be easily defined
- Logistical constraints prevented large scale monitoring efforts and necessitated selection of specific, representative locations for pilot study year
- Proximity to the Merced River (within ¼ mile of ordinary high water in Yosemite National Park boundaries, and within the 100-year floodplain or River Protection Overlay in El Portal)

Procedures: National Park Service Resources Management and Science staff and Practitioner representatives from the Southern Sierra Miwuk Tribe of American Indians visited numerous sites in Yosemite Valley in search of those that met the above criteria. After representative sites were selected, they were documented using GPS and marked to enable re-location for monitoring. Methods for sampling varied among species due to differences in population characteristics and growth habits. Specific individuals were chosen for monitoring for blue elderberry and redbud, and 25m^2 plots within selected stands were utilized for monitoring bracken fern and showy milkweed. Stand selection within the sample site were based on the following criteria:

- High usability of plant stand by American Indian Practitioners (i.e. high plant quality, sandy-loam soil conducive to bracken fern rhizome harvesting)
- Size of patch (must be large enough to encompass a 25 m^2 plot)
- Varying proximities to impact zones (i.e. roads, social trails, and invasive plant species)

Sampling schedule: Practitioner assessments should be conducted when the species monitored have reached the lifestage where they would be harvested for traditional use. Timing of monitoring will vary from year to year depending on environmental conditions affecting plant growth and development, such as water availability. The following comprises a tentative monitoring schedule for 2006:

- Bracken fern and showy milkweed: August or September
- Redbud and blue elderberry: September or October

B.8.3 Field Methods

- **Preparation:** Prior to the beginning of the field season, National Park Service Resource and Management staff will meet with Practitioners to confirm protocols and to schedule monitoring efforts. The day before scheduled field work is to occur, National Park Service staff will relocate, using site maps and GPS, and mark the selected species plots/individuals with flagging to expedite the monitoring process.

Data collection and measurement: If Practitioners feel comfortable, National Park Service field staff will accompany Practitioners during assessment to (1) facilitate locating of plots, (2) conduct photo-documentation, and (3) to document site characteristics: presence of visitor impact, presence of invasive plant species within 10m, general site observations, and qualifications of site for Criteria for Cultural Place (see NPS Documentation sheet). Extensive efforts must be made by NPS field staff to maintain the confidentiality and anonymity of traditional Practitioners and Ethnobotanical Resources monitoring locations (e.g. uniforms will not be worn during monitoring). If practitioners prefer, NPS staff can perform these duties at a separate time.

If possible, three Practitioners will conduct separate assessments at each monitoring site to facilitate quality control of the rating system and increase reliability.

Practitioner Assessments data sheets will include the following:

- **Date:** Record the date of monitoring
- **Practitioner(s):** Record the name of the practitioner or practitioners performing the assessment

- **Age of practitioner(s) and/or number of years experience**: Record the age of practitioner or practitioners and the number of years they have had gathering the plant species for the indicated purpose(s)
- **# of usable stems / berry bunches:** Record the number of stems of each type (clapper, stave, etc.) or berry bunches that meet the listed criteria
- **# of broken usable stems/ berry bunches:** Record the number of stems of each type (clapper, stave, etc.) or berry bunches that meet the listed criteria that are broken
- **Overall usability assessment:** Rate the individual for overall usability related to each specific use. A rating of "0" indicates no usability for that particular use, a rating of "1" indicates extremely poor usability for that particular use, and a rating of "10" indicates optimal usability for that particular use, with intermediate numbers reflecting a gradient of usability within those parameters.

8.4 DATASHEETS

Figure B.8.1 National Park Service Documentation Datasheet

VERP 2006 – Usability of Ethnobotanical Resources

Name:

Date:

Site:

Evidence of visitor impact (e.g. trampling, garbage, etc.):

Presence of invasive species within 10m (yes or no, and list spp.):

General site observations (e.g. plant health [water stress, pathogen stress, etc.], degree of visitor presence):

Criteria for Cultural Place, based on National Register #38: (circle the criteria that apply to this site; only one is needed)

The National Register's standards for evaluating the significance of properties were developed to recognize the accomplishments of all peoples who have made a significant contribution to our country's history and heritage. The criteria are designed to guide State and local governments, Federal agencies, and others in evaluating potential entries in the National Register.

Criteria for Evaluation

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded or may be likely to yield, information important in prehistory or history.

*This information is from the National Park Service National Register of Historic Places website: http://www.cr.nps.gov/nr/listing.htm

FIGURE B.8.2 Practitioner Assessment: Blue Elderberry at Cascades

VERP 2006 – Usability of Ethnobotanical Resources
Date:
Practitioner(s):
Age of practitioner(s) and/or number of years experience with gathering species:

Blue Elderberry #1 (next to bridge)			
Traditional uses / use criteria	**# of useable stems / berry bunches**	**# of broken usable stems/ berry bunches**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use 1 (stems): Clapper • 1½-3 inches in diameter • "Straight" shoot 12-24 inches • Pith greater than ½ diameter of stem			**0 1 2 3 4 5 6 7 8 9 10**
Traditional Use 2 (stems): Staves • ¾ inches in diameter • "Straight" shoot 6-12 inches • Pith greater than ½ diameter of stem			**0 1 2 3 4 5 6 7 8 9 10**
Traditional Use 3 (stems): Flutes • ½ inches in diameter • "Straight" shoot 6-18 inches • Pith greater than ½ diameter of stem			**0 1 2 3 4 5 6 7 8 9 10**
Traditional Use 4 (stems): Fire Drill • ½ inches in diameter • 2½-3 feet in length • Pith greater than ½ diameter of stem			**0 1 2 3 4 5 6 7 8 9 10**
Traditional Use 5 (berries): Food • Good taste			**0 1 2 3 4 5 6 7 8 9 10**

Notes:

FIGURE B.8.2 Practitioner Assessment: Redbud at Redbud Launch

VERP 2006 – Usability of Ethnobotanical Resources
Date:
Practitioner(s):
Age of practitioner(s) and/or number of years experience with gathering species:

Redbud #1 (center circle)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Basketry • "Straight" shoot 6" – 6 ft. • Un-branched • Primary growth (first year's growth, new)			**0 1 2 3 4 5 6 7 8 9 10**

Redbud #2 (small redbud next to social trail)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Basketry • "Straight" shoot 6" – 6 ft. • Un-branched • Primary growth (first year's growth, new)			**0 1 2 3 4 5 6 7 8 9 10**

Redbud #3 (roadside)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Basketry • "Straight" shoot 6" – 6 ft. • Un-branched • Primary growth (first year's growth, new)			**0 1 2 3 4 5 6 7 8 9 10**

NOTES:

Figure B.8.4 Practitioner Assessment: Showy Milkweed in El Cap Meadow

VERP 2006 – Usability of Ethnobotanical Resources
Date:
Practitioner(s):

Showy Milkweed Plot #1 (near large black oak, adjacent to North Side Drive north-center of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

Showy Milkweed Plot #2 (under large snag in the center of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

Showy Milkweed Plot #3 (on bank of Merced River on south end of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

Showy Milkweed Plot #4 (adjacent to Merced River on east end of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

*Please include notes on back of form

Figure B.8.5 Practitioner Assessment: Bracken Fern in El Cap Meadow

VERP 2006 – Usability of Ethnobotanical Resources
Date:
Practitioner(s):

Bracken Fern Plot #1 (under large ponderosa pine in center of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

Bracken Fern Plot #2 (near shallow swale and large ponderosa pine in center of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

Bracken Fern Plot #3 (near black oak grove in southeast corner of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

Bracken Fern Plot #4 (adjacent to South Side drive in northeast corner of meadow)			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal] (circle one)**
Traditional Use (stems): Cordage • Need to establish criteria			**0 1 2 3 4 5 6 7 8 9 10**

See attached NPS Documentation and Practitioner Assessment datasheets

Post-collection and processing: Digital photographs will be downloaded upon return to the office of Vegetation and Restoration, and datasheets will be copied and stored in two different locations (VERP office in Yosemite Valley and Vegetation and Restoration office in El Portal).

End of season procedures: Site visit should be arranged to address any concerns from field season, and Park Staff should get an informal statement of Practitioner involvement in maintenance or tending activities, as this will affect the usability of plant species.

B.8.5 Data Management

Data entry: Collected data will be entered into a database, and digital photographs will be labeled and filed electronically. Field notes will be transferred into digital form (i.e. word processed) by field technicians following field work.

Data analysis: Translate practitioner counts into usability classes using the following table:

Table B.8.1 Usability classes for "Number of usable stems" and "Number of broken usable stems", from Practitioner Assessment of Traditional Plant Resources.

Original practitioner count	Usability class
1-10	1
11-20	2
21-30	3
31-40	4
41-50	5
51-60	6
61-70	7
71-80	8
81-90	9
91-100+	10

*These classes may be revised following practitioner determination of inter-species variation in stem counts and subsequent effects on usability.

Compare results to 2005 data to determine any changes in usability of Ethnobotanical Resources in the samples assessed. (Sample sizes will not be sufficient to conduct statistical tests; therefore results will be strictly descriptive)

Data reporting: Practitioner assessments, data analysis results, and NPS documentation will be formalized in the 2006 VERP Annual Report, which will be published on Yosemite National Park's website and will be available at future public meetings and open houses.

Data storage: All collected data and compiled documentation will be stored on the YOSE NPS network (ms01/EP Resources/reso/Restoration Program Commons/VERP/VERP 2006/Ethnobotanical Resources). GIS maps and project files can be found at (ms01/EP Resources/reso/Restoration Program Commons/GIS data/VERP/2006/Ethnobotanical Resources). Original datasheets will be stored in the office of Vegetation and Restoration.

B.8.6. Personnel Requirements and Training

Roles and responsibilities (tasks and time commitments): GS-7 coordinator will have the responsibility of organizing Practitioner-NPS meetings and interactions, while following the structured protocol for intra-nation communication by notifying the necessary parties (e.g. NPS Tribal Liaison, Southern Miwuk Tribal Liaison). GS-7 coordinator will also most likely serve as the field technician for completing NPS documentation of monitoring sites and facilitating practitioner assessments. Projected time commitment would be a total of four days for protocol refinement and preparation for field season, three days prior to field work to organize and conduct meetings, four days of field work, and four days of data entry and reporting.

Qualifications: GS-7 coordinator should have a general understanding of plant biology and physiology, have the ability to identify the species being monitored, and have been familiarized with proper procedures for nation-to-nation correspondence and related conduct. Familiarity with resource impact assessments and visitor use is also helpful.

Training procedures: Practitioners should review the criteria set forth by their tribal representatives for the individual uses for each species (e.g. Fire-drill length and diameter). NPS staff should make sure that they are able to correctly identify plant species and use the provided maps and GPS to re-locate monitoring sites.

B.8.7. Operational Requirements

Field work plan:

- Day 1: NPS locates and flags showy milkweed and bracken fern monitoring sites in El Capitan meadow, and practitioners conduct assessments of these species
- Day 2: Assessment of blue elderberry and redbud monitoring sites
- Day 3 (if necessary): Finish assessments

* Prior to field work, meetings will be scheduled to coordinate schedules, confirm understanding of protocol and participant expectations, etc.

Safety: A job hazard analysis has been completed for this indicator. See table below (Table B.8.2.).

Table B.8.2 Job Hazard Analysis for Ethnobotany Indicator Data Collection

United States Department of Interior NATIONAL PARK SERVICE	1. WORK PROJECT/ACTIVITY	2. LOCATION	
	VERP Ethnobotanical Resources	Yosemite Valley, YNP	
Job Hazard Analysis (JHA)	3. NAME OF ANALYST	4. JOB TITLE	5. DATE PREPARED
	Crystal Elliot	Technician	July, 2005
6. TASKS/PROCEDURES	7. HAZARDS	8. ABATEMENTS ACTIONS ENGINEERING CONTROLS – SUBSTITUTION – ADMINISTRATIVE CONTROLS – PPE	
a. Driving to, from, and around sampling sites.	a. Collision resulting in damage, injury, or death.	a. Drive defensively, obey traffic laws, lights on, seatbelt on, be alert for pedestrians, wildlife, and distracted drivers. Know procedures for installing snow chains. Always carry and know how to use a Park radio.	
b. Walking, hiking and other physical exertion.	b. Exhaustion, muscle strain, dehydration and fatigue.	b. Drink plenty of fluids, bring snacks and/or meals if out during lunch hours, Take periodic rests and stretch before and after physical activity.	
c. Hiking through and working in meadows.	c. Inclement weather, heat, dehydration; poison oak; insects and snakes.	c. Dress appropriately, drink plenty of fluids, bring snacks and/or meals if out during lunch hours, carry first-aid kit including snake-bite kit and Tecnu, in case of contact with poison oak. An Epy pen may be necessary to carry as well.	
d. Working and walking along riverbanks.	d. Tripping and/or falling due to wet and slippery rocks or sloping ground surfaces, contact with poison oak, etc.	d. Watch footing, know how to identify and avoid all poison oak, rinse immediately in stream if contact occurs.	
e. Working outdoors in cold and/or wet weather.	e. Hypothermia, reduced resistance to illness.	e. Wear appropriate clothing and carry extra layers. Stay dry. Use rubberized raingear if possible. Stay hydrated preferably with warm liquids. Stop work to warm up if necessary. Snack often.	
f. Working outdoors in hot / extreme heat weather.	f. Fatigue, exhaustion, dehydration and heat stroke.	f. Wear appropriate clothing and use sunscreen. Drink fluids and snack throughout the day. Carry extra water and dehydration salts along with first aid kit.	
10. SUPERVISORS SIGNATURE	11. TITLE	12. DATE	

Equipment and materials: The following materials and supplies should also be acquired:

- Map with location/directions to monitoring sites
- Map identifying known archeological sites in proximity to target sites
- Meter tapes (2) (may be needed to aid in locating plot corners)
- Meter sick/ruler (for practitioner measurements of criteria)
- Pin flags
- Flagging
- Compass
- GPS device
- Digital camera and compass headings from 2005 photopoints
- Datasheets on waterproof paper and blank paper for notes
- Copy of VERP Ethnobotanical Resources monitoring protocol on waterproof paper
- Clipboard/pencils

Plant press and plant identification guide (to collect any unknown invasive plant species)

Budget:

- Term GS-7: ~4 weeks at $1000/week = $4000
- Vehicle: 1 vehicle for 0.5 months at $650/mo = $325
- Supplies: $25

Total = $4350

B.8.8. References

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APPENDIX A:
GLOSSARY OF TERMS AND ACRONYMS

GLOSSARY

Azimuth: This is the direction of a celestial object, measured clockwise around the observer's horizon from north. So an object due north has an azimuth of 0°, one due east 90°, south 180° and west 270°. Azimuth and altitude are usually used together to give the direction of an object in the topocentric coordinate system.

Carrying Capacity: As it applies to parks, carrying capacity is the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purpose of a park unit and its management objectives.

Geographic Information System (GIS): A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface. Typically, a Geographical Information System (or Spatial Information System) is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature. Each feature is linked to a position on the graphical image of a map.

Global Positioning System (GPS): The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS.

Indicator: Indicators are specific, measurable physical, ecological, or social variables that reflect the overall condition of a management zone. Resource indicators measure visitor impacts on the biological, physical, and/or cultural resources of a park; social indicators measure visitor impacts on the park visitor experience.

Management zone (zone): A geographical area for which management directions or prescriptions have been developed to determine what can and cannot occur in terms of resource management, visitor use, access, facilities or development, and park operations.

Outstandingly Remarkable Values (ORVs): Those resources in the corridor of a Wild and Scenic River that are of special value and warrant protection. ORVs are the “scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values…that shall be protected for the benefit and enjoyment of present and future generations” (16 USC 1272).

River corridor: The area within the boundaries of a Wild and Scenic River (e.g., the Merced River corridor).

Standard: Standards define the desired condition of each indicator variable. A standard does not define an intolerable condition, but rather the minimum acceptable condition.

User capacity: As it applies to parks, user capacity is the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions based on the purpose and objectives of a park unit.

Visitor experience: The perceptions, feelings, and reactions a park visitor has in relationship with the surrounding environment.

Visitor Experience Resource Protection (VERP): A process developed by the National Park Service to manage the impacts of visitor use on the visitor experiences and resource conditions in units of the national park system.

Wetland: Wetlands are defined by the U.S. Army Corps of Engineers (CFR, Section 328.3[b], 1986) as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wild and Scenic Rivers: Those rivers receiving special protection under the Wild and Scenic Rivers Act.

Wilderness: Those areas protected by the provisions of the 1964 Wilderness Act. These areas are characterized by a lack of human interference in natural processes.

Wilderness Impact Monitoring System (WIMS): An inventory process that monitors campsite and trail conditions in Yosemite National Park backcountry and Wilderness.

ACRONYMS

C	Centigrade
CA	California
CCC	Continuing Calibration Check
CD	Compact Disc
cfs	cubic feet per second
cm	centimeter
CMP	Comprehensive Management Plan
DH-81	Standard USGS wading sediment / water sampling device
DH-95	Standard USGS suspended sediment / water sampling device
DO	Dissolved Oxygen
DI	Deionized Water
DOQs	Digital Orthophotos
EPA	Environmental Protection Agency
EDI	Equal Discharge Increment
EWI	Equal Width Interval
GIS	Geographic Information System
GPS	Global Positioning System

HCl	Hydrochloric Acid
Hg	Mercury
ICC	Initial Calibration Check
KCl	Potassium Chloride
L	Liter
mg/l	Milligram per Liter
ml	Milliliter
MDL	Method Detection Limit
mm	Millimeter
MPN	Most Probable Number
NAD27	North American Datum 27
NAD83	North American Datum 83
NELAP	National Environmental Laboratory Accreditation Program
NFM	National Field Manual
NIST	National Institute of Standards and Technology
NPS	National Park Service
PDA	Personal Data Assistant
pH	Potential Hydrogen
QAPP	Quality Assurance Project Plan
QC	Quality Control
SOP	Standard Operating Procedure
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
µS	Micro-Siemens (a measure of electrical conductivity)
µmhos	Micro-mhos (inverse of micro-ohms, a measure of electrical resistance)
VERP	Visitor Experience and Resource Protection
WIMS	Wilderness Impacts Monitoring System

APPENDIX B:
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